

OBITUARY NOTICES OF FELLOWS DECEASED

BETWEEN 30TH NOV. 1865 AND 30TH NOV. 1867.

Dr. BENJAMIN GUY BABINGTON was born in 1794. He was the son of Dr. William Babington, who, in his time, held a foremost place as a popular and successful London physician. Educated at the Charter House, he subsequently went through the usual course of study at Haileybury College then required of young men destined for the Indian Civil Service; he went out to the Madras Presidency as a member of that service in 1812. After remaining seven years in India, he was compelled by ill health to return home, and then determined to leave the Indian Service and adopt his father's profession. With this view he entered at Pembroke College, Cambridge, and took the degree of M.B. in 1825, and that of M.D. in 1830. In the meantime he commenced practice in London, and in 1831 was elected a Fellow of the College of Physicians. For the prosecution of his medical studies in London he had chosen Guy's Hospital, where his father was physician, and he was himself appointed assistant physician to that Institution in 1837, and promoted to be one of the physicians in 1840.

Dr. Babington was much esteemed as a clinical teacher, and was the author of papers on different professional subjects, published in the Guy's Hospital Reports, and elsewhere; but he also engaged in researches of more general scientific interest, and among them his observations on the blood, published in the 'Medico-Chirurgical Transactions' of 1830, deserve especial mention, inasmuch as he there showed that the liquid part of the circulating blood, or "liquor sanguinis" (a name proposed by him to distinguish it from the serum, and very generally adopted since), really contains or yields the coagulable matter, or fibrin, which solidifies in the process of coagulation. This, no doubt, was merely a confirmation by simple but well-devised experiments of the doctrine held by Hewson and his contemporaries, and accepted by most British physiologists; but the confirmation was needful and well timed on account of the erroneous views then prevailing on the continent on the authority of Prevost and Dumas. At a later time, namely in 1859, Dr. Babington communicated to the Royal Society a series of observations on the effect of various salts dissolved in water in retarding or otherwise altering the rate of spontaneous evaporation, and an abstract stating the nature and results of the experiments was published in the 'Proceedings' for 1859.

In the establishment of the Sydenham Society, since succeeded by the new Society of the same name, Dr. Babington took an active share. Up to the time of its dissolution he acted as Treasurer, and contributed to its publications an elegant translation of 'Hecker's Epidemics of the Middle Ages,' besides aiding in the revision of other works published by the Society. The Epidemiological Society, founded in 1850, owes its origin mainly to his exertions. He was its first President, and continued in that

office, taking part with unabated interest in its useful labours, till within a short time of his death.

It remains to be added that Dr. Babington was a man of varied accomplishments. He had a refined taste in art, and applied his hand in some of its departments with no mean success. He had great readiness and skill in devising and constructing apparatus and instruments of various kinds, and mechanical appliances for the ease and comfort of the sick. It is especially worthy of note that in 1829 he communicated to the Hunterian Society of London a method of inspecting the fauces and glottis in the living person by means of a small mirror passed back into the throat ; so that, for aught that appears to the contrary, Dr. Babington is entitled to the credit of having made the first practical step in the art of laryngoscopy.

Dr. Babington was elected a Fellow of the Royal Society in 1828 ; in 1861-63 he served on the Council. His death took place on the 8th of April, 1866.

WILLIAM THOMAS BRANDE, D.C.L., F.R.S., was born on the 11th of January, 1788, in Arlington Street, St. James's, London, and died at Tunbridge Wells on the 11th of February, 1866, in the seventy-ninth year of his age.

When about six years of age he was placed in a private school at Kensington, where he remained four years. At this school he made tolerable progress in the rudiments of the Latin language, and learned to read Greek. On leaving it he was sent to Westminster, where, during a period of eight years, he made fair progress in classical and general knowledge. His father, who was an apothecary, suggested that he should select the Church for his future career ; but he preferred the medical profession, and on the 2nd of February, 1802, according to the custom of those days, he was bound apprentice to his brother, who was a Member of the Society of Apothecaries. The family removed from Arlington Street to Chiswick, and here it was that Mr. Brande first became acquainted with Mr. Charles Hatchett, whose daughter he subsequently married. Mr. Hatchett at this time was much occupied in chemical investigations, and it appears to have been from his conversation and example that the subject of this memoir first acquired a strong attachment to Chemistry and Mineralogy. He often assisted Mr. Hatchett in his laboratory, and he received from him specimens of minerals which formed the foundation of a collection which he kept up through life. He was then simply a schoolboy fond of science, and this feeling was encouraged and developed by the kindness and attention of Mr. Hatchett. He had then no idea that chemistry would be his future profession.

In the year 1802, when in his fourteenth year, he paid a visit to his uncle at Hanover, and here he acquired a good knowledge of the French and German languages. In the spring of 1803 he visited Brunswick and Göttingen ; but all his plans of study were interfered with by the breaking

out of the war and the approach of the French to Hanover. With some difficulty he escaped to Hamburg, and reached London after passing a month at sea in a Dutch merchant-vessel.

In 1804 he resumed his duties as apprentice to his brother, and in the autumn of that year, and in the seventeenth year of his age, he became a pupil at the Anatomical and Medical School in Windmill Street. He attended the lectures of Mr. Wilson and Mr. Thomas, and it was during this period of study that he made the acquaintance of Brodie (the late Sir Benjamin), Maynard, Ewbank, and other professional men of repute. He now studied chemistry under Dr. George Pearson, and became one of his pupils at St. George's Hospital. He here made the acquaintance of Dr. C. R. Pemberton, and by the aid of this gentleman he acquired a considerable knowledge of disease and a great liking for the practice of physic. About this time also he found a friend in Sir Everard Home, who was then in the zenith of his reputation.

A weekly meeting was held on Saturday evening at the Windmill-street School: this was founded on the ruins of the once celebrated Lyceum Medicum, and it may be regarded as the parent of the Westminster Medical Society. The meetings were attended by many medical men of repute; medical and scientific papers were read and discussed; and as chemistry was very often the subject of inquiry, Mr. Brande found that he was frequently referred to as an authority on matters connected with this science. Writing of this date, Mr. Brande states:—

“I was now full of ardour in its prosecution (*i. e.* of chemistry); and although my brother, with whom I still lived, whose apprentice I was, and in whose shop, notwithstanding all other associations, I still worked and passed a large part of my time, threw every obstacle in the way of my chemical progress that was decently in his power, I found time, however, to read, and often to experiment in my bedroom late in the evening. I thus collected a series of notes and observations which I fondly hoped might at some future period serve as the basis of a course of lectures, and this in time they actually did. It was at this period that, in imitation of Mr. Hatchett's researches, I made some experiments on Benzoin, the results of which were published in Nicholson's Journal for February 1805.”

This, it may be remarked, was his first chemical contribution to scientific literature. He was then only about sixteen years of age. Mr. Brande also contributed to the same journal for June 1805 a paper on Respiration, which had been read to the Westminster Medical Society.

His first introduction to Sir Humphry Davy was about the year 1801, when he was a boy at Westminster School, then in his thirteenth year. He was introduced to Davy at the Royal Institution, which had been recently founded. After his return from Germany in 1804, he renewed his acquaintance with Davy, and, as a result, his zeal in the pursuit of chemistry was greatly augmented. Sometimes he stole away from home, or, instead of going to the Anatomical School in Windmill Street, contrived

to get admitted to one of Davy's lectures at the Royal Institution. It appears that at this time he formed a resolution of losing no opportunity that should present itself to enable him to take the office of a lecturer on chemistry.

In the autumn of 1805 he drew up an account of some experiments on Guaiacum resin. This formed the subject of a paper presented by Mr. Hatchett, and read before the Royal Society on the 19th of December. It was printed in the 'Philosophical Transactions' for 1806. He now became acquainted with Sir Joseph Banks. He was frequently consulted by Sir Everard Home on chemical and physiological questions; and by the advice of Sir Everard he was entrusted with the analysis of the calculi then in the collection of the College of Surgeons. The results were communicated in a letter to Sir Everard, which was read before the Royal Society on the 19th of May, 1808, and published in the Transactions with some observations by Sir Everard Home. Two other papers relating to the state and quantity of alcohol in fermented liquids were published in the Transactions for 1811 and 1813. For these he was presented with the Copley Medal in 1813.

The winter of 1808 was an important epoch in Mr. Brande's life. He being then in his 21st year, commenced lecturing, and gave two courses of lectures on pharmaceutical chemistry at Dr. Hooper's Medical Theatre in Cork Street, Burlington Gardens. These lectures were so well received that Mr. Brande was invited in the ensuing autumn to join the new Medico-Chemical School established by Mr. Wilson in Windmill Street. Dr. Cooke and Mr. Brande lectured there on alternate mornings on physis and chemistry; but the weight of the entire course fell chiefly on Mr. Brande. Dr. Cooke withdrew from the lectures, and in 1813 Mr. Brande joined Dr. George Pearson, who gave medical lectures at his house in George Street. Mr. Brande gave a course of lectures on *Materia Medica* at Dr. Pearson's, and at the same time continued the course of Chemistry at the small laboratory which he had fitted up in Windmill Street.

On the 13th of April, 1809, being then only 21 years of age, Mr. Brande was elected a Fellow of the Royal Society, and took his seat on the 20th of that month. This at once brought him in contact with all the leading scientific men of the day, including Cavendish, the elder Herschel, Maske-lyne, and Wollaston. To all these he soon became intimately known.

On the 4th of November, 1812, Mr. Brande accepted the appointment of Professor of Chemistry and Superintending Chemical Operator to the Apothecaries' Company. This gave him the opportunity of remodelling many of their pharmaceutical processes, and of raising them to the level of the improved state of chemistry. There can be no doubt that Mr. Brande aided in an important degree in resuscitating the character of the Society and giving to it a scientific status. The late Mr. Hennell was his pupil. Mr. Brande was made Professor of *Materia Medica*, and he delivered annually a course of lectures on that subject.

In the spring of 1812, Mr. Davy (afterwards Sir Humphry Davy), with whom Mr. Brande was on cordial and intimate terms, delivered his last course of lectures in the Royal Institution. On the occasion of his marriage at this date he resigned the chair of Professor of Chemistry in the Royal Institution, and invited Mr. Brande to deliver for him a course of lectures which he had been in the habit of giving annually before the Board of Agriculture. These lectures were delivered gratuitously by Mr. Brande; but in the following year this Board was dissolved.

In the winter of 1831, Mr. Brande gave a probationary course of Chemistry at the Royal Institution, and in May of the same year he was unanimously elected Professor of Chemistry. In the autumn of this year he took possession of the apartments that had been occupied by Sir Humphry Davy, and was then completely installed as his successor. Sir Humphry went abroad and did not return for two years.

In October 1815, Mr. Brande transferred the pupils from his School of Chemistry in Windmill Street to the laboratory of the Royal Institution, and he commenced a regular and extended course of lectures on this science. In consequence of the death of Dr. Pearson, the chemical lectures were also transferred from St. George's Hospital to the Royal Institution. His lectures were well attended and contributed to raise the reputation of the Institution as a seat of practical instruction. He was subsequently assisted in these lectures by Mr. Faraday. Mr. Brande devoted himself at this time entirely to chemical pursuits and to lectures on the science.

In 1823 he was consulted by the Government and drew up a report on the manufacture of iron and steel. The manufacture of the metal for coinage formed a part of the inquiry; and the office being vacant in 1825, Mr. Brande was appointed Superintendent of the Die Department at the Royal Mint. In 1854, he resigned his professorship in the Royal Institution, and was made Superintendent of the Coining department at the Mint.

It was in the year 1825 that Mr. Faraday became associated with Mr. Brande in the lectures delivered at the Royal Institution. He also had the assistance of Mr. Faraday in the publication of the 'Quarterly Journal of Science and the Arts,' edited at the Royal Institution. This publication was commenced in 1816, and was carried on until 1836, when it fell into other hands and was soon discontinued. In 1836 Mr. Brande was named one of the original Fellows of the University of London, and a Member of the Senate of that Body; and in 1846 he became Examiner in Chemistry, an office which he retained until 1858. He received the honorary degree of Doctor of Civil Law in the University of Oxford. He was a Fellow of the Royal Societies of London and Edinburgh, and of many other British and Foreign Societies. From 1816 to 1826 Mr. Brande was one of the Secretaries of the Royal Society.

Mr. Brande was the author of a 'Manual of Chemistry,' which went through six editions, of a 'Dictionary of Pharmacy and Materia Medica,'

and of a smaller volume on Chemistry, especially designed for students, published in 1861. In 1842 he undertook the editorship of the 'Dictionary of Science and Art,' a most laborious undertaking; and at the time of his death he was occupied in revising a new edition of this work. His scientific contributions to periodical literature were also very numerous.

From 1808 to 1854, the long period of forty-six years, the subject of this memoir had been before the public as a lecturer on chemistry. He was indefatigable as a teacher of this science. In addition to the lectures regularly delivered at the Royal Institution and the Society of Apothecaries, Mr. Brande lectured for some time on chemistry to the classes at St. Bartholomew's Medical School. Many of the past and present generation, whether in or out of the medical profession, owe much of their knowledge of this science to his teaching. The substance of his lectures is incorporated in the great work by which he acquired a European reputation, namely his 'Manual of Chemistry.' This work was, in its day, one of the most popular in the English language, and there are few recent treatises on the subject which are not indebted to its pages for much valuable information. He found chemistry an ill-arranged collection of facts, and succeeded in reducing them into form and order, thus aiding greatly in the cultivation of the science and in placing it on an intelligible basis.

No scientific man who was brought in contact with Mr. Brande could fail to be struck with the accuracy and extent of his knowledge, the retentiveness of his memory, and the truthfulness and honesty of purpose by which he was always actuated. The friend of Gay-Lussac and Thénard and the associate of Davy and Faraday, he formed a connecting link between the chemists of the past and the present generation. He lived to see the most remarkable changes in the science which he had himself so successfully cultivated, but, like his great contemporaries, he preferred demonstration to speculation; and although ready to adopt what was established by experiment, however it might conflict with his previous views, he was strongly opposed to innovations based upon mere hypotheses. In private life Mr. Brande was well known as a man of genial character. His conversational powers were great, and no man could pass an hour in his society without retaining a pleasant reminiscence of him as a companion.

A. S. T.

WILLIAM BRINTON, M.D., was the second son of the late Mr. Henry Brinton, one of the principal carpet manufacturers of Kidderminster, where the subject of the present notice was born, on the 20th of November, 1823. After attaining remarkable proficiency at school, William Brinton was apprenticed to a surgeon in his native town, and in October 1843 entered the medical department of King's College, having in the preceding summer matriculated, with honours, at the University of London. He passed through his student career with great distinction, and was noted among his fellows not only for the general ability and indomitable perseverance with which he applied himself to intellectual work, but especially for his unde-

viating aim at precision and thoroughness of knowledge in all his studies. The character he bore as a student was honourably maintained at the University of London, where he took the degree of M.B. in 1847, and of M.D. in the following year. In the meantime he was appointed Assistant Demonstrator of Anatomy, and in 1850 Medical Tutor, at King's College, which appointment he held until 1853, when he was elected Lecturer on Forensic Medicine at St. Thomas's Hospital.

To St. Thomas's medical school Dr. Brinton became permanently attached by his being elected Physician to the Hospital in 1860, and appointed Lecturer on Physiology, having previously been associated with the late Mr. Grainger in that lectureship. He soon proved himself to be an able and accomplished teacher of physiology; and those who have heard him lecture speak with admiration of his appropriate language and agreeable delivery, and of the ready power and happy effect with which he used his pencil to illustrate his oral instructions.

From 1852 until his appointment to St. Thomas's in 1860, Dr. Brinton was Physician to the Royal Free Hospital, where he enjoyed large opportunities of medical observation; and during his tenure of that office he published in 'The Lancet' a series of "Clinical Remarks," which were much valued. He speedily rose in the estimation of his professional brethren and gained the confidence of the public, so that for some years before his death he enjoyed a much larger share of consulting practice than usually falls to the lot of young physicians of his standing.

When quite a young man Dr. Brinton contributed several articles to Dr. Todd's 'Cyclopædia of Anatomy and Physiology,' and translated Valentin's 'Text-book of Physiology' from the German. In 1857 he published a work on 'Ulcer of the Stomach,' and, two years later, one of more extended scope, on 'Diseases of the Stomach;' this was followed by a treatise on 'Food and Digestion.' These works were the result of a careful study of a subject to which he had given special attention. He entertained original views on the natural and perverted movements of the alimentary canal, and on the nature and cause of intestinal obstruction, and gave an exposition of his doctrine in the Croonian Lectures which he delivered before the College of Physicians.

Three papers by Dr. Brinton were read to the Royal Society, of which abstracts were published in the 'Proceedings;' viz. "Contributions to the Physiology of the Alimentary Canal" (1848), "On the Dentate Body of the Cerebellum" (1852), and "Experiments and Observations on the Structure and Function of the Stomach in the Vertebrate Class" (1861). He was elected a Fellow of the Society in June 1864.

In a memoir of Dr. Brinton which appeared in 'The Lancet' soon after his death, from which chiefly we have derived the substance of this brief notice, it is mentioned that among his numerous tastes and acquirements was a love of mountaineering, and that he was a member of the Alpine Club, and contributed two papers to the second series of "Peaks, Passes,

and Glaciers.” Dr. Brinton died on the 17th of January, 1867, at the early age of 43. The cause of his death was renal disease of three years duration, against which he had all along borne up with marvellous courage.

Mr. WALTER CRUM, an eminent scientific chemist and manufacturer of Glasgow, was born there in 1796, and died at his residence, the Rouken, near that city on the 5th of May, 1867. He was the second son of Mr. Alexander Crum, of Thornliebank, senior partner in the firm of Alexander and James Crum, long established and much respected as merchant manufacturers in Glasgow. His mother, to whose family his personal characteristics appear to have had the strongest resemblance, was a daughter of the late Walter Ewing MacLae of Cathkin. Having received a liberal education at the Grammar-school and University of Glasgow, he entered upon the business of calico-printing, a department of the work of his father's establishment. With a view to the conduct and improvement of this branch of manufacture he early devoted himself to practical chemistry, and in 1818 and 1819 was an ardent student of that science in the laboratory of Dr. Thomas Thomson—at that time one of the few laboratories, if not the only one in this country, in which analytical research was systematically practised and taught. The intimate knowledge of chemistry which Mr. Crum thus acquired, combined with his general scientific attainments, enabled him to introduce many useful improvements into his own business, and thus to maintain and increase the excellence of its manufactures. As an important example of these may be mentioned the well-known process of “orange resist” on indigo, which was invented and practised for five years by Mr. Crum before it became known to other manufacturers.

Mr. Crum's ability as a chemical analyst, however, gave to his researches a scientific interest and a value beyond that which belonged to their mere practical application; and his first paper on the Analysis of Indigo, published in 1823 in the ‘Annals of Philosophy,’ established his reputation as a scientific chemist, and brought him into correspondence with, and procured for him the friendship of, many of the first chemists of his time, among whom may be mentioned, as the most intimate, Thomson, Faraday, Graham, and Liebig. He became a member of the Royal Society in February 1844. His other scientific papers followed in succession from 1830 to 1861; almost all of them were communicated to and printed in the Proceedings of the Philosophical Society of Glasgow, which he joined in 1834, and of which he became President on the death of Dr. Thomas Thomson in 1852. A list of these papers is subjoined; several of them were translated into German, and published in Liebig's ‘Annalen der Chemie,’ as in vol. lv. (1845), vol. lxii. (1847), and vol. lxxxix. (1854).

The most important of Mr. Crum's researches are those relating to indigo, gun-cotton, the acetates of alumina, and the dyeing of cotton-fibre. It was from Mr. Crum's analysis of sublimed indigo that he was led to

construct the formula for that substance, which is now universally adopted. This analysis was made at a time when accurate organic investigation involved much greater difficulty and the exercise of higher ingenuity than, with Liebig's method, is now required; and although Erdman and Dumas had from their analysis of a less pure substance deduced other formulæ, they afterwards confirmed that of Mr. Crum. The very ingenious method proposed by Mr. Crum for the analysis of nitrates was founded on the conversion of the nitric acid into nitric oxide by the action of sulphuric acid on mercury. He applied this method to determine the quantity of nitrogen in gun-cotton. Having determined the carbon by combustion with chromate of lead, he was led to the formula of $C_{12}H_7O_7 + 3NO_2$ for the most explosive gun-cotton—a result which has recently been confirmed, after the most rigorous investigations, by Mr. Abel and others, and it is now universally accepted. The action of sulphuric acid and mercury on gun-cotton led Mr. Crum to regard the latter as a nitrate, a view which, making gun-cotton analogous to nitric ether, was long opposed by nearly all chemists, but is now very generally adopted.

Mr. Crum's investigation of the acetates of alumina is very able and complete, showing the precipitating action of very dilute solutions of various salts on soluble alumina, in the same manner as he had shown such action at a much earlier date in the case of the sulpho-indigotates and sulpho-phœnicates. His papers on the peroxide of copper and on the action of nitric acid and peroxide of lead as a very delicate test for manganese are esteemed valuable contributions to analytical chemistry.

After the death of Dr. Thomson in 1852, Mr. Crum delivered to the Philosophical Society of Glasgow a discourse on the Life and Labours of his instructor, in which he dwelt with much feeling, ability, and discrimination on the varied acquirements and contributions to science of that eminent and laborious chemist.

Mr. Crum was remarkable for unbending rectitude of purpose and love of truth, for great acuteness of perception and decision of character; and his public spirit was as notable as his perseverance in conducting to a successful termination whatever he undertook. He occupied during many years a high place in public estimation, and took a leading part in every good work having for its object the educational, social, or political improvement of the people.

In his own extensive and interesting works at Thornliebank, he had an ample field for the energetic practical development of his sagacious and benevolent plans for the moral and intellectual improvement of the numerous workmen in his employment. For upwards of forty years Mr. Crum devoted much time and personal effort to furthering the interests of Anderson's University in Glasgow, of which he was a most liberal and effective patron and supporter. His election to the Presidency of that valuable institution gave him ampler opportunity for indulging his favourite desire of bringing scientific knowledge within reach of the artisan and

the general public. In many other ways he contributed to promote the cause of popular education.

Mr. Crum's character was marked by clear intelligence and strong practical sagacity, unbending love of truth and justice, frank sincerity, great kindness of heart, generosity, and active and judicious benevolence, but so unselfish and of such retiring modesty that he shrunk from the slightest display. Few men have lived more usefully, or have died more esteemed and regretted.

List of Papers by Mr. Crum.

1. "Experiments and Observations on Indigo, and on certain Substances which are produced from it by means of Sulphuric Acid," in *Annals of Philosophy* for 1823.

2. "On the Primitive Colours," 1830.

3. "On Chlorimetry, and a New Method of testing weak solutions of Bleaching-Powder," in *Proceedings of the Philosophical Society of Glasgow* for 1841, vol. i. p. 17.

4. "On the Manner in which Cotton unites with Colouring-Matter," 1843, *ibid.* p. 98.

5. "On the supposed influence of the Moon upon the Weather," 1844, *ibid.* p. 243.

6. "On the Action of Bleaching-Powder on the Salts of Copper and Lead," 1845, *ibid.* vol. ii. p. 68.

7. "On the Artificial Production of the Potato-disease," 1845, *ibid.* p. 90.

8. "On a Method for the Analysis of Bodies containing Nitric Acid and its application to Explosive Cotton," 1847, *ibid.* p. 163.

9. "On a peculiar fibre of Cotton which is incapable of being dyed," 1849, *ibid.* vol. iii. p. 61.

10. "Sketch of the Life and Labours of Dr. Thomas Thomson, F.R.S.," 1852, *ibid.* p. 250.

11. "On the Acetates and other Compounds of Alumina," *ibid.* p. 298.

12. "On the Stalactitic Sulphate of Barytes found in Derbyshire," 1861, *ibid.* vol. v. p. 39.

13. In 1862 Mr. Crum greatly extended his previous investigations, chemical and microscopical, on the manner in which cotton unites with colouring-matter, and on a peculiar fibre of cotton which is incapable of being dyed, "coton mort," both of which subjects he had studied very profoundly. The results of these important and difficult investigations, illustrated by numerous engravings, were published in the *Journal of the Chemical Society* for 1863.

JOSEPH EDYE was born at Plymouth Dock (Devonport) in 1791. He entered the Navy in 1805, and served as secretary's clerk under Sir John Duckworth, on board the *Superb* in the action off St. Domingo (for which he in afterlife received a medal), and also on board the *Royal George*, 100

guns, at the passage of the Dardanelles. He attained the rank of Paymaster in 1811, and after service in the *Erne* was employed as Secretary in 1823 and 1824 to the Hon. Alexander Cochrane at Plymouth, from 1824 to 1827 to Lord de Saumarez at the same port, and from 1828 to 1834 to Sir Pulteney Malcolm in the Mediterranean during the pacification of Greece and the expulsion of the Egyptians from the Morea, where he acted as British Commissioner at the headquarters of Ibrahim Pasha, in concert with the Commissioners of France and Russia, for the purpose of rescuing from slavery about 2000 Greek women and children found in the Egyptian camp, on which service he received an injury that subjected him to severe suffering for the rest of his life. He was also with the same gallant commander in the North Sea during the demonstration made on the Dutch coast in 1832 and 1833 at the siege of Antwerp. From 1836 to 1839 he was with Sir Philip Durham, as secretary at Portsmouth, and from 1839 to 1842 with Sir Graham Moore at Plymouth. He was placed on the half-pay of a secretary in 1843, and received a letter of thanks from the Admiralty for his important special services as Secretary to the Commission consisting of Sir P. Malcolm, Sir C. Adams, and Sir T. M. Hardy, which framed the laborious production, 'The Code of Naval Regulations ;' and in 1865 he was appointed Paymaster-in-Chief, and received the Greenwich pension for his past service.

Mr. Edye was elected a Fellow of the Royal Society in January 1841. He died at his residence, Stoke, Devonport, November 12, 1866, leaving a widow and one son, a midshipman in the Navy.

SIR GEORGE EVEREST was born at Gwernvale (Brecon), the seat of his father, Mr. Tristram Everest, on the 4th of July 1790. In his early studies at Woolwich he made such progress that he was found qualified for a commission before the age prescribed by the regulations, and was noticed by the Professor of Mathematics, Dr. Hutton, as one who would distinguish himself. In 1806 the young cadet sailed for India, where he entered the Bengal Engineers, and after seven years' service, was sent to join a detachment in Java. There Lieut. Everest was selected by Sir Stamford Raffles, then Governor, to make a survey of the Island, in which laborious task he spent two years, and afterwards returned to Bengal. He was next employed in engineering works (improving the navigation of the outlets of the Ganges), and though appointed Chief Assistant on the Great Trigonometrical Survey of India in 1817, he remained for some months in Hindoostan to complete the establishment of a line of telegraphic posts from Calcutta to Benares.

In 1818 Captain Everest joined the party under Lieut.-Col. Lambton, Superintendent of the Survey at the headquarters, Hyderabad. Well qualified for this appointment by education and habit, he entered with great spirit on the duties by which his name has become noteworthy in the annals of Geodesy. Before that survey was undertaken the topography of

India was as incorrect as it was scanty ; there was an error of forty miles in the breadth of the peninsula as laid down in the maps, and it was in consequence of a resolution of the East-India Company to amend this unsatisfactory state of things, by making their Atlas depend on trigonometrical operations, that the survey was commenced.

Captain Everest was carrying the work through an unhealthy part of the Nizam's territory when, in 1820, his health failed, and he was ordered to the Cape of Good Hope to recruit. Here he employed his leisure in an examination of the tract of country in which La Caille measured an arc of the meridian in 1752 ; and in a letter to Colonel Lambton he reviewed the circumstances under which the measurement had been made, and pointed out the discrepancies between the results and those obtained in similar operations in the northern hemisphere. This letter, printed in the first volume of 'Memoirs' published by the Astronomical Society, led eventually to the remeasurement and extension of La Caille's arc by Sir Thomas Maclear.

On the death of Colonel Lambton in 1823, Captain Everest was appointed Superintendent of the Survey, and devoted himself earnestly to the work. In the same year he took up the survey where his predecessor had left it in the valley of Berar, and extended it into the mountainous tract on the north. In November 1824 he measured a base-line in the Seronj valley, and in 1825 had carried the observations on to Bhaorasa, when his health again gave way, and he was compelled to seek the restorative climate of his native land.

Profiting by his sojourn in England, Captain Everest made himself acquainted with new scientific results bearing on his special pursuit. He was elected a Fellow of the Royal Society in 1827. Part of his time was spent in drawing up an account of the progress of the survey* subsequent to the operations recorded by Lieut.-Col. Lambton in the 'Asiatic Researches,' which, with tables, maps, and plans, was published at the cost of the East-India Company, by whose authority it had been prepared. In this work, among the many scientific details, Captain Everest gives a few particulars of his personal adventures in the carrying on of the work—of the severe measures by which he disciplined his native followers and quelled a mutiny among them—of separation from his instruments and provisions by sudden floods—of the explorations through wild jungles in search of favourable observing stations—of journeyings through vast and magnificent forests where, more to be dreaded than tiger or hyæna, lurked the deadly typhus which prostrated him and his whole following. For months he was so weak that he had to be supported by two men while taking his observations at the great theodolite, and could not reach out his hand to the screw of the vertical circle without assistance ; yet, though

* An account of the measurement of an arc of the meridian between the parallels of $18^{\circ} 3'$ and $24^{\circ} 7'$, being a continuation of the grand meridional arc of India, as detailed by the late Lieut.-Col. Lambton. 4to, London, 1830.

advised to resort to the coast, he persevered with his task, having a conviction that his absence would be fatal to its prosecution.

Colonel Everest returned to India in 1830, enabled to effect improvements in the survey, for he had made himself acquainted with the practice of the English Ordnance Survey, and with the best methods employed in Geodesy in other parts of Europe; besides which the Directors of the East-India Company had furnished him with the best instruments that could then be constructed. His labours and responsibilities were now largely increased; for in addition to his post as Chief of the Trigonometrical Survey, he had been appointed Surveyor-General of India. In 1832 he resumed operations on the great arc, from which date it was diligently carried on until its completion in December 1841 by the remeasurement of the Beder base-line by Captain Waugh*.

In this renewal of observations, one of Colonel Everest's principal difficulties was the training of assistants. In some other respects the fatigue and risk were mitigated; by the use of proper signal-lights, the surveying could be carried on at night and during the hazy period of the hot winds, whereby the parties were less called on for exposure during the rainy season. The chief himself was so indefatigable, that his contemporaries, playing on his name, were accustomed to speak of him as *Neverrest*. With his improved instruments, he was resolved to improve the Survey and tolerate no inferiority in the execution. On this point he writes, "If I have had any reason to suspect any defect in the instrument, or any instability in the platform, or any want of precision in the signal observed, or even if I have found in drawing up the angles that they presented any discrepancies for which I could not account, I have always felt not only that I was at liberty, but that it was incumbent on me to reject the whole set bodily, and replace it by an entirely new set of angles taken under circumstances free from objection."

With these concluding operations an arc of meridian more than twenty-one degrees in length had been measured by the two persevering chiefs of the Survey and their assistants, extending from Cape Comorin to the northern border of the British Possessions in India. Colonel Everest had speculated on carrying it further, beyond the Himalayas and across the wild regions to the north, until it struck the Russian triangulation within the dominions of the Czar. An arc stretching from the Indian Ocean to the Polar Sea would, indeed, as he himself describes it, have been "a vast project."

In 1843 he quitted India, and residing thenceforward in England, he brought out in 1847 his great book in two volumes quarto, 'An Account of the Measurement of two Sections of the Meridional Arc of India, bounded by the parallels of $18^{\circ} 3' 15''$; $24^{\circ} 7' 11''$; and $29^{\circ} 30' 48''$.' In this work, published also at the cost of the East-India Company, such particulars are set forth as will enable a scientific observer to test the manner of working and the results obtained, and full explanations are given of

* Now Major-General Sir A. Scott Waugh, F.R.S.

the ingenious methods devised by the author for the elimination of error, together with tables, plans, and engravings of the instruments employed. For this work, and the long series of operations on which it was founded, the Royal Astronomical Society awarded their testimonial (equivalent to a medal) to Colonel Everest. "The Great Meridional Arc of India," said Sir John Herschel in presenting the testimonial, "is a trophy of which any nation, or any government of the world have reason to be proud, and will be one of the most enduring monuments of their power and enlightened regard for the progress of human knowledge."

The Asiatic Society of Bengal, on completion of the Survey, elected Lieut.-Col. Everest one of their Honorary Members, with an appreciative eulogium of his scientific services. He was a Fellow of the Astronomical and of the Royal Asiatic and the Geographical Societies. Of the latter he was a member of Council, and filled the office of Vice-President. He was knighted and made C.B. in 1861. His scientific writings are comprised in the two works above mentioned, in papers on subjects connected with surveying published in 'Asiatic Researches' and in the 'Memoirs' of the Astronomical Society, and in a letter on certain computation errors discovered in the logarithm tables of the Great Survey, printed in the 'Proceedings' of the Royal Society.

In 1863-65, Sir George Everest served on the Council of the Royal Society. He died in London, December 1, 1866. His name having been given to one of the highest summits of the Himalayan range, will long be remembered in India.

JOHN GOODSIR, Professor of Anatomy in the University of Edinburgh from 1846 to 1867, was born in the year 1814, at Anstruther in Fife, in which county his father and grandfather were well known and much respected medical practitioners.

When little more than a boy he was sent as a student of arts to the University of St. Andrews, where he passed through the curriculum, but, as was the custom at that time, without taking his degree. At this early period of his life he was fond of the study of metaphysics, and imbibed the doctrines of Coleridge, which indeed gave a colour to the whole of his subsequent thoughts and speculations.

Being destined to follow the medical profession, he was apprenticed to Mr. Robert Nasmyth, the eminent Dentist in Edinburgh, and during his apprenticeship pursued his medical studies in the University and Royal Infirmary in that city. His anatomical teacher was Dr. Knox, and in his practical rooms he made the acquaintance of Edward Forbes, which soon ripened into friendship. For Forbes and Goodsir had tastes in common; they both took an active interest in watching the habits and tracing out the structure of animals, and their conjoint researches added several new members to the British fauna.

When he had obtained the Licence of the Edinburgh College of Sur-

geons, Mr. Goodsir returned to Anstruther, where, whilst assisting his father in practice, he found time to pursue his anatomical and zoological studies, and in 1838 brought before the British Association his observations on the Development of the Teeth.

Shortly after this he returned to Edinburgh to fill the office of Conservator of the Museum of the College of Surgeons, for the duties of which he was well adapted, not only from his anatomical knowledge, but from his skill in preparing and displaying anatomical and pathological specimens. He now became a Member of the Wernerian, Botanical, Medico-Chirurgical, and Royal Societies of Edinburgh, and communicated to their Proceedings and Transactions numerous memoirs, which rapidly brought him into notice as an industrious and keen observer of animal form and structure in both healthy and morbid conditions. His well-known papers on *Sarcina*, on the anatomy of *Amphioxus lanceolatus*, on secreting structures, and on the structure of the placenta may be mentioned as examples of his work at this period.

In 1842-43 he delivered lectures at the College of Surgeons, in which he enunciated his views on various important physiological and pathological processes, which were subsequently incorporated, along with some observations by his brother Harry, in an octavo volume published in 1845. In these lectures he contended that the nucleus of the cell was a persistent element of the textures, that it existed even within the bone-corpuscles, that it played a most important part in the nutrition of the textures, and that great multiplication of the nuclei occurred in disease of cartilage, bone, and other tissues.

In 1844 he was appointed Demonstrator of Anatomy in the University to Dr. Monro *tertius*, and on the resignation of that gentleman in 1846 he succeeded him in the Chair of Anatomy, an office which he continued to hold until his death. In the same year he communicated to the Philosophical Transactions a Memoir on the Development of the Suprarenal, Thymus, and Thyroid Glands, and was elected a Fellow of the Royal Society.

Mr. Goodsir enjoyed for many years remarkable success as a teacher. He gathered together a large number of students, and for several years the attendance on his class numbered between 300 and 400. In his Lectures on Human and Comparative Anatomy he did not satisfy himself with giving a mere descriptive account of the various structures he was called on to expound, but he pointed out the relations of his science to physiology, pathology, histology, morphology, and development. It was to this mode of illustrating the dry details of anatomy, more perhaps than to any special faculty for exposition, that his success as a teacher was due. He worked most assiduously at Comparative Anatomy, and by his labours the collection in the Anatomical Museum of the University has been very largely increased, partly by the specimens added during his lifetime, and partly by the purchase of his private collection since his decease. In 1850 he projected and

edited the *Annals of Anatomy and Physiology* ; but as his health shortly afterwards began to give way, the journal, after three numbers had been published, was discontinued. In 1853 he was obliged to withdraw for a year from active work ; and though after his return from the continent he resumed the duties of his chair, yet he had to depute much of the work he had at one time performed to an assistant. He still continued, however, his original investigations, and in 1856 published a series of memoirs on the morphology of the skeleton. The mechanism of the joints also attracted a large share of his attention, and he has left behind him some manuscript essays on this subject which will shortly be published in the collected edition of his writings. The paralytic affection from which he suffered gradually impaired the vigour of his constitution. At the close of 1866 he could no longer attend to the duties of his class, and he died at Wardie, a suburb of Edinburgh, on the 6th of March, 1867. The retired life he had led for many years before his death gave him much time for private study, and his extensive knowledge of modern languages, as well as the excellent library he had collected, made him well acquainted with the progress of anatomy in all its departments. He worked at his science in a high-toned, philosophic, and most honourable spirit ; and in his scientific and personal relations he strove to be candid and just to all men.

WILLIAM GRAVATT was born at Gravesend in 1806. His father, Colonel Gravatt, having been appointed Inspector of the Royal Military Academy, settled with his family at Woolwich ; and here William Gravatt acquired his first practical knowledge in military and civil engineering. He was sent in due time to the establishment of Messrs. Donkin and Co. to be prepared for his future profession of civil engineer, and soon secured the good opinion of his masters as well as the regard of his fellow pupils. During his engagement with Messrs. Donkin he was employed for some time at the Thames Tunnel, and was twice instrumental in saving the lives of men who were working there. His first independent employment was in 1832, when he was appointed Engineer to the Calder and Hebble Navigation at Halifax. In 1833 he removed to London, and was elected a Fellow of the Royal Society. About this time he invented the level which bears his name, and introduced the system of reading the staff with the telescope, instead of trusting to the staff-bearer—a method of working which has long superseded all other modes of observation. Mr. Gravatt also contrived another instrument, which he called a Nadir, of great value in carrying out a system of levels in cases when there were obstacles to the employment of a regular staff of assistants. When M. Scheutz brought over his calculating machine to this country in November 1844, Mr. Gravatt announced its arrival to the Royal Society, and took a lively interest in it. He further undertook to explain the mechanism and operation of the machine to men of science and others who chose to inspect it, and afterwards proceeded with the machine to Paris for the same purpose. He

also superintended the publication of a volume of Specimen-Tables calculated and printed by its agency. In 1856 Mr. Gravatt read to the Royal Society a paper upon the theory of the Gyroscope, which was at that time exciting much interest in the scientific world. About the same time he published a short pamphlet upon the propulsion of ships by means of a jet of water, an application of power which seems now likely to be brought into practical use.

Mr. Gravatt's life was unfortunately terminated on the 30th of May, 1866, by the accidental administration of an excessive dose of morphia.

CHARLES JAMES HARGREAVE was born near Leeds in December 1820. After leaving his school (Bramham College) he distinguished himself at University College, London, and took the degree of LL.B. with honours in the University of London. From 1843 to 1849 he was Professor of Jurisprudence in University College. Having acquired a high reputation at the equity bar, he was appointed in 1849 a Commissioner of the Incumbered Estates Court in Ireland. Those who know the nature of the duties and the state of things for remedy of which the court was created, will be aware that a singular combination of legal knowledge, sound judgment, and imperturbable temper was required. All were found in Mr. Hargreave, as was soon seen and acknowledged. The condition of those who came under the jurisdiction of his Court was described, we believe by Mr. Hargreave himself, in a manner which, all jokes being logical fallacies, has no worse fault than the sophism of a part for the whole. He said that punch was no longer known in Galway, only toddy; for whiskey and sugar could be got on credit from Dublin, but lemons required ready money. Of himself, his colleague (Judge Longfield) wrote as follows:—"It may be said that his first experience in a court of justice [he had been a conveyancer and draughtsman] was to preside in it as judge. But no person could observe any deficiency. His patience, his learning, and his impartiality quickly received the respect and confidence of the practitioners in his court, and his unequalled sweetness of temper made him a general favourite. . . . But he was most in his element when an unusual combination of circumstances and complicated deeds seemed to produce inextricable confusion. His habits of order and his fine mathematical mind at once arranged the rights of the parties with a certainty approaching mathematical demonstration. He never seemed happier than when he was engaged in a subtle mathematical analysis, or in determining the rights arising from a deed when every event occurred except those contemplated by the conveyancer who drew the instrument."

Judge Hargreave (so entitled from 1858, when the court was made permanent) died at Bray, County Wicklow, April 23, 1866. There is no doubt that his constitution was destroyed by his junction of two severe intellectual pursuits; and there is too much reason to fear that the excitement

of his last effort, presently noticed, was the immediate cause of his death. He became a Fellow of the Royal Society in 1844. In the 'Transactions' for 1848, 1850, 1858 appear his papers on Differential Equations, on Linear Equations of Differentials and of Differences, and on the Problem of Three Bodies, the first of which received a Royal Medal. His other communications are to the Philosophical Magazine, 1847-1864. One separate and posthumous work, 'An Essay on the Resolution of Algebraic Equations,' 1866, 8vo (printed for private circulation), demands notice. This speculation especially refers to equations of the fifth degree, or *quintics*. Mr. Hargreave believed himself to have arrived at a solution in the same sense and manner as the cubic has long been solved. The solution of the cubic is not quite pure. An expression having nine values, or three triplets, gives in each triplet the three roots of one of three cubics, which only differ in containing different cube roots of unity. Mr. Hargreave alleges that he produces five similarly associated quintics, of which the five quintuplets of roots can be given in an expression of the 25th degree. The complexity of the analysis, compared with that of a quadratic, is probably in even a higher ratio than the complexities of the *discriminants* (p. 9) of a quintic and a quadratic; and there will be very few readers. The result cannot yet be pronounced upon; but assuredly the thought and the skill employed will remain the subjects of lasting admiration.

His old teacher, Mr. De Morgan, informs us that the most remarkable point, though not the greatest, about Mr. Hargreave was the change in his handwriting. From sixteen to eighteen years of age he wrote in a manner which almost required a microscope to decipher; his examination-papers put the proof of the binomial theorem into the area of a visiting card. He emerged from his legal studies with a round Roman hand of more than average size, and much more than average legibility.

On the 22nd January, 1867, died at Plymouth SIR WILLIAM SNOW HARRIS, Kt., in his seventy-fifth year. He was the only son of Thomas Harris of Plymouth, Solicitor, whose family had settled in that town as early as the year 1600. He was educated first at the Grammar School at Plymouth, after which he entered the medical profession, and completed his studies in Edinburgh. Harris commenced the practice of his profession as a militia surgeon, and afterwards became a general practitioner in Plymouth; but his love of science, especially of electricity, interfered with his practice.

In 1820 he invented a system of lightning-conductors, by which he became more generally known than by his discoveries. This system had reference chiefly to the defence of the Royal Navy from the destructive effects of lightning, and its peculiarity consisted in permanently fixing sufficiently massive copper bands in the masts, and in leading these copper lines along the ship's timbers to the copper sheathing, so as to afford the

required security at all times, and under all the variable circumstances in which the ship might be placed.

In 1824 Harris married the eldest daughter of Richard Thorne, Esq., of Pilton, North Devon, and from this time he chiefly devoted himself to the cultivation of electrical science. The earlier results of his study at this period were for the most part laid before the Royal Society of Edinburgh in a series of papers, the first of which, entitled "Experimental Inquiries concerning the Laws of Magnetic Forces," appeared in the 'Transactions' in 1829; but the paper is dated Plymouth, July 1, 1827. It contains an account of the hydrostatic magnetometer. The second paper, "On a new Electrometer, and the heat excited in metallic bodies by Voltaic Electricity," is dated May 5th, 1831. The third paper, dated April 5th, 1833, is "On the Investigation of Magnetic Intensity by the Oscillations of the Horizontal Needle." By this time the author had been elected a Fellow of both the London and Edinburgh Royal Societies.

The bent of Harris's mind for improving and constructing electrical instruments is shown at this early period. Indeed his connexion with the Royal Society was in a great measure due to this cause. The President, Sir Humphry Davy, having been attracted by his electrical thermometer, invited him to give an account of it to the Society, which he did in 1826; and his first paper appeared in the Philosophical Transactions under the following title: "On the relative powers of various metallic substances as conductors of Electricity."

Harris's researches on some of the elementary laws of electricity appeared in the Philosophical Transactions in 1834, 1836, and 1839, and they display in a striking manner the author's ingenuity and delicate manipulative skill. He was not satisfied with the attainment of his end by *any* means, but the means themselves were the subject of long and patient thought and repeated trials, until the best means possible under the circumstances had been hit upon. This care in the selection and improvement of apparatus might seem to an ordinary observer to be often superfluous, but it led to success, and to the thorough understanding of the conditions of success; so that the ultimate failure of an experiment in Harris's hands became next to impossible. But with all this love of apparatus, and of its minute details, Harris had none of the spirit of a mere mechanical artist; he knew that the best instrument does the best work only under the guidance of the best mind. But Harris's ingenuity was by no means confined to his apparatus. There was not a room in his house, from the attic to the kitchen, that did not bear marks of an original mind. He converted the ceiling of his children's nursery into a planetarium, and the floor into a compass card. He did not disdain to invent a child's toy, or to rectify a defect in his ingenious kitchen range.

In 1835 the Copley Medal, the "olive crown" of the Royal Society, as Davy loved to call it, was bestowed on Harris in recognition of the value of his papers on the laws of electricity of high tension. In 1839 his

“Inquiries concerning the Elementary Laws of Electricity” formed the subject of the Bakerian Lecture.

In the midst of these researches concerning the general doctrines of electricity, Harris had never ceased to labour at the practical question of the protection of ships from lightning. Erroneous views on the subject were then common; highly educated men and naval officers were found to affirm that lightning-conductors did more harm than good; that they attracted lightning to the structure they were intended to protect, and more to the like effect. A mixed commission of naval and scientific men was at length appointed by Government to take the whole subject under review. The committee met several times in the rooms of the Royal Society at Somerset House, and Harris was called upon to give his evidence. Dr. Wollaston took great interest in the inquiry, and was present during Harris’s experiments, which were so satisfactory that the committee earnestly recommended his system for general adoption in the Royal Navy. Still, however, he had much opposition to contend with. Trial had been made of his conductors in the case of ten ships sent to various parts of the world, and experience had fully proved their value, yet an order was given (or threatened) for the removal of the conductors from each ship as soon as it came into dock. But in the mean time the protective effects of his system were so strikingly exhibited on shore, that the order above referred to was never carried out. Some granite chimneys in the victualling-yard at Devonport were in the course of being fitted with the conductors. In the case of one chimney the fittings were completed, in the other the work was delayed in consequence of some adverse order. A storm passed over Plymouth, the protected chimney was unhurt, the unprotected one was struck and rent asunder.

Harris’s conductors now began to find favour at the Admiralty, and the scientific discoveries of their inventor were at length recognized in the same quarter, so that he was recommended to the Government as worthy of an annuity of £300 “in consideration of services in the cultivation of science.” Prejudices against his system, however, lingered in the minds of naval men and others, and in order to remove them Harris published in 1843 his well-known work on ‘Thunder Storms.’ He endeavoured also, in papers in the Nautical Magazine and in separate pamphlets, to spread information concerning damage by lightning. He was always on the watch for an illustrative example, and once he got the trace, never gave it up until he had tracked it to the ship’s log deposited in Somerset House, or obtained an account from the captain or one of the officers of the ship that had been struck. Accounts of such cases, in the form of letters or pamphlets, he caused to be circulated among persons in authority, including the various foreign ambassadors; and it may be mentioned that Harris’s system was adopted in the Russian Navy before it was fully admitted into our own. In 1845 the Emperor presented Harris with a valuable ring and a superb vase, in acknowledgment of the merits of his system.

At length all difficulties in the way of his long-cherished object were overcome. The various objections to his conductors had been met, the merits of his system were clearly understood, and its adoption in the Royal Navy was secured. It was then also felt that some further public recognition was due of the benefit thus conferred on the Naval force and maritime industry of this country and the world. Accordingly, in 1847 the honour of knighthood was conferred upon him, and soon afterwards a grant of £5000 was made to him by Government, in consideration of his public services. In 1850 he was elected an Honorary Member of the Naval Club at Plymouth, and in 1854 of the Royal Yacht Club at Cowes, as an especial acknowledgment of his services to the Royal Navy. Nothing could be more congenial to his tastes, for he was always more of a sailor than a landsman. He had a yacht of his own, and was never tired of exercising it; but he loved to be on the sea in whatever craft.

In the midst of his multiplied engagements Sir William did not forget the claims of elementary instruction in science. The Manuals of Electricity, Magnetism, and Galvanism published in Weale's "Rudimentary Series," and which had a large sale, testify to the activity of his mind in this direction.

Harris's sympathies were with the Bennetts, the Cavendishes, the Singers, the Voltas of a past age: Frictional electricity was his *forte*, and the source of his triumphs. He was bewildered and dazzled by the electrical development of the present day, and almost shut his eyes to it. He was attached too closely and exclusively to the old school of science to recognize the broad and sweeping advance of the new. He was not conscious even of being behind his age when he presented to the Royal Society in 1861 an elaborate paper on an improved form of Bennett's discharger, and still less in 1864, when he discussed the laws of electrical distribution, and still relied upon the Leyden jar and the unit-jar.

Although Sir W. Harris's powers as a scientific inquirer cannot be reckoned as on a par with those of some of his great contemporaries, he was highly ingenious and inventive, a clear thinker, and a suggestive writer. He did his work well, and left his mark on the science of his day; and while some of his labours will be forgotten and others be absorbed and blended with the branch of physical science that he cultivated, still there are many points in Harris's character as a man, and in his habits as a philosopher, which will be dwelt on with pleasure and profit.

In August 1861, on returning from an excursion in his yacht, Sir William was seized with a painful disease of the eyes (*iritis*), which did not yield to medical treatment during some months. He was confined to the house until the following May. In the autumn of 1862, in consequence of a return of the malady, he underwent two painful operations; but the result eventually was, that he lost the sight of one eye, and found the vision of the other much impaired, and his general health weakened.

Recovering, however, in some measure, from this trying illness, he be-

came most anxious to complete a work the materials for which had been accumulating during a series of years. This was a complete Treatise on Frictional Electricity, to which he intended to add biographical notices of the leading electricians of the past. He had also prepared a minute account of the history of the Leyden jar. The first portion of this work was completed, under the supervision of the author, at the close of 1866, when Sir William was seized with his last illness, which ended fatally on the evening of the 22nd January 1867. He bore his sad calamity during five years and a half with the greatest patience, calmness, and fortitude, and was never heard to murmur.

Dr. WILLIAM HENRY HARVEY was born near Limerick, on February 5, 1814. Educated at Ballitore School, Kildare, his youth was spent in his father's office at Limerick; but a love of natural history very early developed itself, and even while engaged in business he found time to pursue botanical studies with ardour and success, contributing in 1832 and 1834 articles on "Algæ" to Sir William Hooker's 'British Flora,' to the 'Botany of Beechey's Voyage,' and to Mackay's 'Flora Hibernica.'

His scientific zeal led him in 1835 to accompany his brother to the Cape of Good Hope, to which colony the latter had been appointed Treasurer and Registrar-General. The results of his botanical studies during his stay there he embodied in numerous contributions to periodical literature, and in his 'Genera of South African Plants,' a work the second edition of which was nearly ready at the time of his death. He came home from the Cape in 1839, but returned again in the following year to fill the place of his brother, who had died on the voyage home.

In 1844 he returned to Ireland upon being appointed Keeper of the Herbarium to the University of Dublin. He also received the honorary degree of M.D. of that University, and was soon after elected Professor of Botany to the Royal Dublin Society. His botanical zeal and energy manifested itself by the commencement, in 1845, of the publication of his 'Phycologia Britannica,' a magnificent work, the numerous plates of which were drawn, lithographed, and coloured by himself.

Upon the occasion of being invited to deliver a course of lectures on Algæ before the Lowell Institute, Boston, U.S., he travelled in North America during 1849-50, carefully exploring the coast from Halifax to the Keys of Florida, and collecting material for a large work, the 'Nereis Boreali-Americana,' which was published by the Smithsonian Institute. During 1853-56 he made a long tour in the Southern Hemisphere, the University of Dublin continuing to grant him his full salary, and Professor Allman delivering his lectures to the Royal Dublin Society. Visiting Ceylon, Australia, Tasmania, New Zealand, the Friendly and the Fiji Islands, he investigated and collected the algæ of these countries, and on his return home published a part of his results in his 'Phycologia Australis.'

In 1859 he commenced, in conjunction with Dr. Sonder and with the assistance of the Cape Government, a complete description of the flowering plants and ferns of South Africa, in a work entitled "*Flora Capensis*," the chief share in the labour of which fell to Dr. Harvey. As a companion to this he also commenced a series of illustrations under the title "*Thesaurus Capensis*." Neither of these works did he live to see completed.

In 1856, the Chair of Botany in the University of Dublin becoming vacant through the removal of Professor Allman to Edinburgh, Harvey was chosen to fill it, and about the same time he was appointed lecturer at the Irish Museum of Industry.

Unhappily his unceasing labours began to tell upon his health; and though he recovered from a severe illness which prostrated him in 1861, his condition in 1864 became so alarming that he was obliged to pass the following winter and spring in the south of France. The improvement he experienced there was, however, but temporary; and after another winter spent at Dublin in painful attempts to finish the works he had begun, he removed to Torquay, where he died, May 15, 1866.

He was thus cut off before he could receive the full acknowledgment of his many services to science. He had, however, achieved a great reputation as a botanist, and on his own especial subject of Algæ he was admitted to be the first authority. He was an accurate and careful observer; the numerous illustrations, all drawn and lithographed, and many coloured, by his own hand, are evidence that he spared no pains to make his works trustworthy and sure, while the personal expense and risk to which he exposed himself both in his exploring expeditions and in his literary undertakings, testify to his devotion to science. He was as modest as he was meritorious, and his personal character endeared him greatly to his friends. His election to the Royal Society is dated June 3, 1864.

PERCIVAL NORTON JOHNSON died on the 1st of June, 1866, aged 73. He was the only son of John Johnson, at one time the only commercial assayer in London; and after working with his father for some years, he established himself in Hatton Garden half a century ago.

He rapidly rose to the highest eminence as an assayer and metallurgist; and his opinion was so much sought after that he could hardly get through the work which crowded upon him.

It is not a little remarkable that the extreme accuracy of his assays was made a ground of objection to them. He for the first time reported the exact amount of gold and silver in the specimens submitted, whereas, before, the quantities had only been stated approximately; and this was not relished by the buyers of bullion, inasmuch as contingent advantages in buying upon exactly known value were not so great. Upon this being represented to him by the merchants, he at once stated that he was willing, if required, to purchase all bars upon his own assays; and this was the reason of his taking

up the refining business, in which he so largely and successfully engaged. His ability in this (as in all other branches that he entered upon) was soon recognized publicly ; and when the gold bars from the Brazilian "Gongo Soco" mines, which came over in very large quantities, were refused at the Mint on account of brittleness, he was consulted on the matter, and undertook to refine and toughen them, in which he perfectly succeeded.

It was in this gold that he discovered the existence of palladium ; and having succeeded in its separation, he introduced it commercially, at once determining and making known the best uses to which it could be applied.

After he had been in business some years he visited Germany, and was much interested in mining operations there, to which he gave special attention. It was at this time that he met with the compound alloy called "German silver," then in a very crude state of manufacture. He brought over with him some of the metal, analyzed it, and upon the basis of his analysis he commenced and carried on its manufacture, and introduced it to general use, laying the foundation of the enormous business which has since arisen in this branch of metallurgy.

About this time he was much engaged in mining pursuits, and was consulted upon, and visited professionally, nearly all the mines in England, Wales, Scotland, and Ireland, and many important ones abroad. He was the first to introduce into Cornwall the German shaking-, jiggling-, and washing-table, with important improvements of his own. He will always be remembered throughout the mining districts for his great kindness and consideration toward the miners, whose social condition it was his constant aim to improve. At great expense to himself, he erected schools in the neighbourhood of the mines, and took an active part in their supervision. He also used his utmost endeavours to alleviate the toil of the workmen in ascending and descending mines, and with this view he, at the Tamar mines, made the experiment of a sloping gallery, which ran for a considerable distance under the river, by which means the miners could walk up and down without the use of a ladder.

Amongst his many inventions of less note may be mentioned several pottery colours, amongst them the "rose-pink," at a time when that colour was much wanted in the potteries.

His greatest success, however, and that which has proved the most valuable to the progress of chemistry and manufacture generally, was the platinum business. To him undoubtedly belongs the credit of having been the first who successfully refined and manufactured platinum upon a commercial scale, and introduced it for the important purposes to which it is specially adapted. The first large and perfect sheet of pure platinum ever produced was made by Mr. Johnson at 79 Hatton Garden ; and, seeing the immense importance of the metal, he ever since made it his speciality.

His eminence as an analyst should also be noticed ; so great was it, that

the only other commercial assayers in London, though his rivals, used to send him all compounds or minerals of a difficult and complicated nature to report upon for them.

Accomplished as he was in his department, and singularly successful in perfecting whatever he undertook, his opinion was always sought for with earnestness and received with confidence. Few men have worked more perseveringly and effectively for the improvement of their profession.

Mr. Johnson was elected a Fellow of the Royal Society on April 30, 1846.

The life of Sir WILLIAM LAWRENCE, Bart., closed on the 5th of last July. He had nearly completed his 84th year. Not more than two years before his death he resigned his active duties at St. Bartholomew's Hospital, but even then he did not cease from work, and was attacked with apoplexy just previous to an examination at the College of Surgeons.

Lawrence, the son of a surgeon, was born on the 16th of July, 1783, at Cirencester, in Gloucestershire. After receiving a preliminary education at a private school, in his seventeenth year he came to London, and was apprenticed to Abernethy, in whose house he resided for five years. But at the expiration of three years, being then only twenty, he was appointed Demonstrator of Anatomy at St. Bartholomew's Hospital. He discharged the duties of this office with remarkable ability for twelve years. When twenty-two, he received the diploma of the Royal College of Surgeons. Eight years afterwards he was appointed Assistant-surgeon to St. Bartholomew's Hospital, and eleven years later still he became one of the principal surgeons. He held this office for more than forty years, and when he retired in 1865, he was unanimously elected by the Governors to the complimentary office of Consulting Surgeon. Thus from first to last he was connected with the hospital for sixty-eight years.

It is well known that at the early period of his life he worked very hard without interruption, as indeed he did almost to the last. Besides discharging his public duties with rare efficiency, he read very much and wrote too. At eighteen years of age he published an anonymous translation of a Latin work—Description of the arteries of the human body, by Dr. Ad. Murray, Professor at the University of Upsal. In his twenty-sixth year he obtained the Jacksonian Prize for an essay on Hernia. This was the foundation of his important book on the subject, which went through five editions. Lawrence on Ruptures has been for many years past, and will be for many years to come, a standard work on the subject of which it treats. It is remarkable, not only for the thoroughly good English in which it is written, and for clearness and justness of thought, but for the mastery of the subject which it exhibits, and for widely extended and accurate research.

In the year he obtained the Jacksonian prize, he published a translation of Blumenbach's Comparative Anatomy. About the same time appeared

his paper on Fungus of the Testis. The novel plan of treatment therein proposed was generally accepted and adopted for many years.

In 1814 he was appointed Surgeon to the London Infirmary for Diseases of the Eye, now called the Royal London Ophthalmic Hospital, and in the following year surgeon to the Royal Hospitals of Bethlehem and Bridewell. These offices he held for many years. He devoted a very large share of his attention to the study of diseases of the eye, and in 1833, after many years of patient observation and reflection, he produced his celebrated treatise on the subject, having previously (in 1830) published a smaller volume on syphilitic diseases of the eye. A comprehensive work, written with all the ability and skill which characterized his work on Hernia, it may be said to have marked an epoch in ophthalmic surgery. It was translated into many languages, a portion of it even into Arabic, and went through many editions in English. The last was published in Philadelphia in 1854.

In 1813 he was elected a Fellow of the Royal Society, and subsequently nominated a Vice-President. But it does not appear that he ever contributed any paper.

In 1815 Lawrence was appointed Professor of Anatomy and Surgery to the College of Surgeons. There, during the years 1816, 1817, and 1818, he delivered those famous lectures on Comparative Anatomy, Physiology, Zoology, and the Natural History of Man, which astonished so many, and aroused such animosity, that had their author been a man of less capability, he would, beyond doubt, have been ruined for life.

The question at issue between the author and his assailants is not one which can be discussed within the limits of this notice. But it may be safely said, that were such a work to appear amongst us now, it would evoke no censure beyond that which lies within the bounds of fair scientific or literary criticism. The doctrine (if it can be so called) which then prevailed concerning the nature of Life, and the weakness of which Lawrence exposed with an unsparing hand, has long since become a dogma of the past; and in the discussion of this great question it is only fair to state that he was far in advance of his time. And, again, his view of the other chief subject, the relation of mind to brain, which was then denounced so fiercely, is (whether right or wrong) identical with that of many of the most enlightened physiologists of the present day. In scientific argument, Lawrence was more than a match for his opponents, but he was assailed by weapons which have happily been since discarded by the champions of knowledge. It may, however, be urged in excuse for the grievous misrepresentation to which he was subjected, that he was not always sufficiently careful to guard against being misunderstood, and proclaimed what he then, and to the last, believed to be the truth, with disregard of, or indifference to, the convictions of those who were then looked up to as the leaders of thought.

In 1816 Lawrence published "An Introduction to Comparative Ana-

tomy and Physiology, being the two Introductory lectures delivered at the College of Surgeons on the 21st and 25th of March, 1816;" and in 1819 he published "Lectures on Physiology, Zoology, and the Natural History of Man." This last was the celebrated volume Lawrence was subsequently induced to suppress; but in 1823, Carlile, without the sanction or consent of the author, indeed, in spite of anything he could do to restrain him, printed and published a volume, entitled "Lectures on Comparative Anatomy, Physiology, Zoology, and the Natural History of Man," which included and was simply a copy of the two volumes mentioned above. Many other editions, variously modified, afterwards appeared. The last, called the 9th, was published by Bohn in 1848.

Lawrence taught at the Aldersgate School of Medicine in 1826-27, but he retired from this in 1829, when he succeeded Abernethy as Lecturer on Surgery at St. Bartholomew's Hospital. He occupied this chair for thirty-three years.

In 1828 he was elected on the Council of the College of Surgeons, and in 1840 one of the Examiners, and subsequently he was twice President of the College. Moreover, he became a foreign Associate of the Institute of France, and a member of a host of other societies. Then he was appointed, at first, Surgeon Extraordinary, and afterwards Sergeant-surgeon to the Queen. Finally, he received a title.

Besides the works already mentioned, Lawrence wrote much. He contributed no less than eighteen papers to the Transactions of the Medical and Chirurgical Society, of which he was for many years a member, and, at one time, President. He wrote many of the articles on Natural Science, some of them at a short notice, in "Rees's Cyclopædia." He contributed also to a work of Watt, entitled "Anatomico-chirurgical Views of the Nose, Mouth, Larynx, and Fauces."

In 1863 (he was then in his eightieth year) was published his last work, "Lectures on Surgery." This, in one volume, by no means embraces the whole course, but only that part of it which was devoted to what may be called the more general subjects, such as the nature of disease, inflammation and its consequences, fever, wounds, and specific diseases. This charming book appeared perhaps somewhat after its time; at all events, it would have produced more effect had its able and accomplished author consented to numerous pressing solicitations to undertake the task—the materials being ready to his hand—many years before. But as it is, better late than never. It is enough to say of it that therein are embodied the most matured experience of the author, and the conclusions at which he had arrived or the opinions he had formed on some of the largest questions which arise in surgery; and moreover it is written with such soundness of judgment and felicity of expression, that it is not only a highly instructive, but a very attractive volume. It is the work not only of a surgeon, but of a scholar.

On two instances Lawrence delivered the Hunterian oration at the Col-

lege of Surgeons. On the last, when the great majority of those whom he addressed were hostile to the views he set forth, his power of public speaking was subjected to a test to which perhaps few men would have proved equal. For the second time in his life did he on a great occasion arouse the anger of his auditory, and excite against himself bitter feeling of resentment. The opinions he expressed on certain questions which were then agitating the minds of many in the profession, and the contempt with which he spoke of certain existing institutions, called forth from all parts of the theatre loud expressions of dissent and denunciation. Probably most of those present thought that the orator would shrink from so unequal an encounter, and bow to the verdict which was so unequivocally pronounced. But Lawrence never for an instant wavered from his purpose. He, standing alone, calm and unshaken by the storm which raged around him, proceeded in a strain of unflinching eloquence to the end, and concluded with a peroration of such power and beauty that those who had, during the hour, been loud in condemnation, could not resist joining heartily in the burst of applause which greeted the close. Undoubtedly he then exhibited some of the greatest qualities of an orator.

Lawrence was indeed richly endowed by nature, and he spared no pains to turn his great advantages to good account. Throughout his long life he enjoyed almost uninterrupted health ; for within not many months of his death, he declared that he had never been kept from his duties by illness for a week together. His excellent health, notwithstanding hard work, continued through so many years with scarcely any intermission, although no doubt originally the result of an unblemished constitution, was yet, from first to last, carefully preserved by habits of singular regularity and uniform temperance in all things. No man could be less self-indulgent than he, no one was ever more orderly in his work or punctual to his engagements. In person too he was much admired. Above the ordinary height, elegant in form, strikingly handsome, and of noble presence, few who met him could have failed to be impressed. But Lawrence was still more remarkable for his powers of mind. His intellect, naturally of extraordinary strength and amplitude, had been very long and most industriously cultivated. Throughout his life, from the time when he first entered the hospital to its close, he was a diligent student, not of surgery only, in its highest and widest sense, and of those natural sciences upon which it is more immediately founded, but even of subjects less akin than those are to that which formed the business of his life.

Apart from all professional knowledge and skill, Lawrence was undoubtedly an accomplished man. He was a good classical scholar, and spoke fluently French, German, and Italian. His knowledge of history, both ancient and modern, was extensive, and in some parts perhaps profound. To the last he was true to the habit of his whole life. He not only read very much, and remembered to an extraordinary degree what he read, but thoroughly digested it, separating with remarkable skill the wheat from

the chaff. But beyond the more immediate occupation of his life—surgery, his chief affection was centred in those sciences which are included in Biology. He was not content to cultivate these sciences only, so far as they are supposed to be directly applicable to practice, but, from first to last, he pursued them for the charms they possessed. The zeal with which he studied, especially in early life, anatomy and physiology, human and comparative, is well known. Throughout his long career his interest in these subjects never flagged.

Again, it is acknowledged by those most competent to judge, that he wrote well. His style was excellent—correct, perspicuous, and graceful. He spoke, too, admirably. Whether in private or in public, he never appeared at a loss either for thought or expression, but was always lucid and to the point. From egotism and all affectation he was supremely free.

Although he was very fond in his later years of discussing with his friends any of the great questions of physiology, it does not appear that he ever committed his thoughts to writing. But those who listened with delight to his conversation were often led to regret that he was never induced to set forth his views in a more permanent form. There was something very attractive in the power of mind and range of knowledge which he, on almost all occasions, seemed to hold in reserve. But two facts especially impressed themselves on those who talked with him. He was always thoroughly well read in the subject, and his views, unfettered by prejudice, were ample and enlightened.

As a surgeon, Lawrence was distinguished rather by his clear and vigorous conception of principles than by any special or peculiar skill in the details of practice. His was no low or narrow view of the requirements of surgery; its practice in his hands was no mere empirical or mechanical art, but he thought it worthy of the highest powers of the intellect. He was no mere skilled artisan, but a thorough philosopher. His great ability was never more conspicuous than in prognosis. At times, with marvellous dexterity, he would predict the issue of a case which baffled or misled every one around him. Thus his most daring achievements as an operator were often crowned with success, which to others appeared in the distance as the remotest chance.

As an operator, he was decidedly skilful; but his skill was shown not so much in grace of action or in apparent manual dexterity, as in the ability with which he accomplished the end in view, and the manner in which he brought the operation to a close. Near-sighted in early life, his vision in his declining years, except towards the end, not only did not fail, but in some respects improved. To the last he operated without glasses, and those which for some years he occasionally used at other times, still later he almost entirely laid aside.

All his colleagues and pupils, and many others, were familiar with his amazing coolness and perfect self-possession under the greatest difficulties. He seemed never to be disturbed, even by the most perplexing and unto-

ward occurrence. Beyond the faintest blush which, perhaps, now and then for a moment passed over his countenance, no indication of any kind appeared that he was in the least degree affected. This wonderful equanimity made him the same at all times and under every circumstance. Whatever he may have occasionally felt was known only to himself. So far as observation went, the worst difficulties of an operation, or the storm of an indignant assembly, alike failed to evoke any evidence of emotion.

In the memoir of Sir Benjamin Brodie, which appeared in the Proceedings of the Society, it was truly said, "There is no profession where a man may in his lifetime be so distinguished, and leave behind so slight a record of his life, as the profession of Medicine or of Surgery. With the death of the man, there perishes in such case a vast amount of personal skill and observation, which, being unwritten, and, indeed, not capable of being written, can be amassed again only by the combination of similar talent, opportunity, and industry in another individual." Lawrence was an eminent illustration of this. Great and various as the merits are of the chief of his published works, they afford no adequate conception of their author. Lawrence, too, was greater in speech than in writing: as a lecturer, in his best days, he was probably without a rival; and those who knew him well will endorse the opinion of Sir Benjamin Brodie, that he was even greater in ordinary conversation than in public speaking. But, in truth, just as now his fame will not rest upon any single brilliant discovery, but upon the record of his whole work, so during life he was not remarkable for one great faculty in particular, but rather for that harmonious combination of various powers which made his character so complete. As a surgeon his name must ever be amongst the foremost of those which adorn the annals of his profession.

W. S. S.

JOHN LEE, eldest son of John Fiott (a descendant of an old Burgundian family), was born April 28th, 1783. He entered St. John's College, Cambridge, and in 1806 was fifth Wrangler, the senior for that year being Sir Frederick Pollock. In 1816 he took his degree of LL.D., and was afterwards elected a Fellow of the College, when, as Travelling Bachelor, he travelled widely on the Continent and in the East, during which time he gathered materials for the interesting collection of antiquities, which were subsequently arranged at Hartwell. In 1815 he changed his name by royal licence from Fiott to Lee, in compliance with his uncle's will, his mother having been daughter of William Lee, Esq., of Totteridge Park, and granddaughter of Sir William Lee, Lord Chief Justice in 1754.

In 1827 Dr. Lee succeeded to the whole of the family property, and became Lord of the manors of Hartwell, Stone, and Bishopstone, and patron of the livings of the two places first mentioned. The presentation to these livings he afterwards conferred on the Royal Astronomical Society, of which he was Treasurer from 1831 to 1840, and President in 1861-62.

A few papers on archæological subjects constitute nearly the whole of Dr. Lee's contributions to literature; but as a patron he excelled, and well deserved the designation of "our science-loving friend," bestowed on him by the late Admiral Smyth. One of his favourite occupations was the increase of the collections he had brought home from his travels; and visitors to the stately mansion of Hartwell will remember the pride with which the venerable owner conducted them from room to room, and fondly described his various treasures. His appreciation of antiquities led to his being chosen as Chairman of the Congress of the Archæological Association and two local societies, which met on Bosworth Field in 1862.

Dr. Lee's chief claim to scientific consideration was the building of an observatory in the grounds at Hartwell, where for many years observations were carried on, which are of recognized value in astronomical and meteorological science. It was there that Admiral Smyth continued his 'Cycle,' which was afterwards published, in the handsome quarto known as 'Speculum Hartwellianum.' The cost of this and three other works, by the same hand, 'Descriptive Catalogue of a Cabinet of Roman Imperial large Brass Medals,' 'Ædes Hartwellianæ,' containing an account of the scientific observations there made by different observers, and of the mansion and its valuable contents, and 'Addenda' to the same, was defrayed by Dr. Lee.

Dr. Lee was twice married, but died without issue. He was a Member of Doctors' Commons, in which he served the offices of Treasurer and Librarian, though he never entered actively into the practice of his profession. His appointment as Queen's Counsel by Lord Chancellor Westbury in 1864, afforded him high gratification. At the time of his decease he was the oldest magistrate in Buckinghamshire, having been named on the Commission of the Peace in 1819.

Though somewhat eccentric in manner, Dr. Lee was considerate and bountiful to those around him. As a master and landlord he was much respected. He gave a thousand guineas towards the establishment of the Bucks County Infirmary. He founded the Lee Fund of the Royal Astronomical Society for the relief of widows and children of deceased Fellows, and presented to the Society the 'Lee Circle,' a valuable astronomical instrument. He was elected a Fellow of the Royal Society in 1831, and at the time of his decease, which took place February 25, 1866, was a Fellow of the Society of Antiquaries, of the Linnean, Geological, the Syro-Egyptian, and other learned bodies.

SAMUEL ROFFEY MAITLAND died January 19, 1866, aged 74. His father was a merchant, of Scotch extraction, and in England a Nonconformist. The son was brought up in his father's persuasion, and accordingly, though he was for some time at Cambridge, he could not proceed to a degree. He was of St. John's College from October 1808 to February 1810, when he migrated to Trinity College, where, however, he never went into residence. He was called to the bar, practised for a year with good success, and then

abandoned the profession. He soon married, and settled at Taunton, where his father also settled. He then began the course of reading and collection of books, which formed the basis of his future career. In 1821 he took orders in the Establishment, and became the incumbent of a new church at Gloucester. This post he resigned in 1830, having in the mean time found that his vocation lay towards theological writing; he had then published various controversial tracts on the prophecies. In 1838 he was appointed librarian to the Archbishop of Canterbury (Howley), from whom he received the degree of D.D.; at the death of that prelate, in 1848, he returned to Gloucester, where he passed the rest of his life. From 1838 to 1865 is the period in which the works were produced which made him conspicuous among writers on mediæval history and theology.

We need not enumerate Dr. Maitland's numerous and multifarious writings; perhaps the most read is the 'Dark Ages, a Series of Essays,' in indication of the period so called from the common charge of neglect of literature and of the text of the Sacred Scriptures. He was not a popular writer; his subjects are too recondite, and his learning too profound.

But he is one of a class of whose writings it must be said, that wherever they take they bite. They are imbued, but not in excess, with a kind of humour which seems almost their own; some would describe it as quaint, but this word alone only distinguishes its class from others; a journalist describes it as "sly, dry, and shy, but never high." It has more likeness in it to the peculiar humour of Pascal than is seen in any other writer of our day. The character of Dr. Maitland's learning is that of the man who reads books which he has always by him, as distinguished from that of the man who knows how to go to the library and find by references. He had nothing to do with libraries except his own, and that of which he was for ten years *in loco possidentis*. Of this library he published a list of the English works previous to 1600 which are found in it, with valuable biographical references. As well as a man of letters, he was a book-fancier, and in early life a little of a bibliomaniac. His taste for these articles led him, when he first began to collect, to learn to bind them; and the writer of this notice remembers endeavouring, when a boy, to extract a book lettered 'Maitland's Works,' and finding that he was trying his strength upon one of the uprights of the bookcase, all of which were backed and lettered by the owner.

Dr. Maitland became a Fellow of the Society in 1839. He was for some years Editor of the 'British Magazine.' Cautious in the highest degree about literary investigation, he was by temperament a bold schemer. Long before Sir Rowland Hill appeared in the field he proposed to the Minister of the day that the Government should carry letters *for nothing*; he was satisfied that the deficit would be much more than made up by the impulse given to trade; and there are presumptions in favour of his view in the extraordinary tendency upwards of the revenue since the great change in the Post Office. In literature he was decidedly of opinion that it would be

amply worth its cost for the Government to pay for the construction of an index which should give reference to every human name mentioned in every book, from the invention of printing down to a recent period.

GEORGE RENNIE, C.E., was born in the parish of Christchurch, Surrey, on the 3rd of December, 1791, and died on the 30th of March, 1866, at his house in Wilton Crescent, London.

He was the eldest son of the great engineer John Rennie, and from his early years was destined for his father's profession. His school education was commenced under Dr. Greenlaw, of Isleworth, and continued at St. Paul's School under the mastership of Dr. Roberts. He was then sent to the University of Edinburgh to pursue his academical studies, and during two years of his stay enjoyed the great advantage of living in the house of Mr. Playfair, the accomplished Professor of Natural Philosophy, and author of the celebrated 'Illustrations of the Huttonian Theory of the Earth.' On his return to London in 1811 he entered on the practical study of engineering, and was soon able to assist his father in all the departments of his profession.

In 1818, on the recommendation of James Watt and Sir Joseph Banks, he was appointed to the office, then become vacant, of Inspector of Machinery and Clerk of the Irons (*i. e.* dies) at the Royal Mint; and during the eight years that he held the appointment he made himself intimately acquainted with the construction and operation of the machinery employed in coining. The knowledge thus acquired stood him in good stead when he was called on, in conjunction with Messrs. Bolton and Watt, to furnish machinery for the Mints of Calcutta and Bombay, and, at a later time, for those of Mexico, Peru, and Lisbon, and when, in the reign of Louis Philippe, he designed similar but more extensive machinery for the Paris Mint.

On the death of his father he entered into partnership with his younger brother, now Sir John Rennie, and went through a long and active professional career, during which the brothers were engaged in designing and executing many engineering works of great magnitude and importance, at home and abroad. Among these may be mentioned various national harbours and docks and their subsidiary machinery; extensive drainage works; railway surveys and constructions, and as specially worthy of note, the first surveys of the present line of the Liverpool and Manchester railway, boldly and successfully carried by the Messrs. Rennie's advice over the Chat Moss, and the Namur and Liege, and Mons and Ménage lines, planned and executed by them in Belgium; also bridges in various parts. London Bridge was erected after a design made by George Rennie, which had been approved by his father; but in consequence of his then holding a government appointment his brother was appointed engineer to carry the work into execution. The Bridge over the Dee at Chester, with an arch of 200 feet span, is a monument of Mr. George Rennie's skill in this species of construction. The original design of this great stone arch was by Mr. Harrison, a well-known

architect ; but as, through age and infirmity, he was unable to proceed with it, the whole plan was remodelled and rendered practicable, and the arch equilibrated with great scientific precision by Mr. Rennie, who further showed his constructive power by devising a very ingenious centre for supporting the arch during the process of building.

Mr. Rennie took much interest in the question of propelling vessels by the screw. The screw-propeller had been already tried at various periods and in various forms. Mr. Rennie's attention was specially drawn to the subject in 1836, by certain successful trials then made by Mr. Pettit Smith with a screw-propeller fitted to a small open boat. After due consideration of the results of this experiment, Mr. Rennie was satisfied that the method would be practicable and advantageous when applied on a larger scale, insomuch that he and his brother, at no small pecuniary risk, combined with some other enterprising persons to carry it into effect, and a vessel called the 'Archimedes' was built for the purpose, and fitted with a screw driven by engines of 80 horse-power. Notwithstanding adverse predictions, the 'Archimedes' succeeded perfectly ; and the Messrs. Rennie subsequently, in 1840, constructed for the Admiralty an iron vessel of 210 tons and fitted it with a screw-propeller, by which a speed was obtained of twelve and a quarter miles per hour, which was four miles above the rate of the Admiralty paddle-steamers of that period. This vessel, the 'Mermaid,' was the first screw-propelled ship in the British Navy, and her introduction is a memorable event in the history of steam navigation.

Throughout his busy practical life Mr. Rennie bestowed much time and thought on the scientific side of his profession, and undertook various experimental inquiries on physical questions connected with it. Three papers containing the results of some of his investigations are published in the *Philosophical Transactions*, viz. "On the Strength of Materials," in 1818 ; "On the Friction and Abrasion of the Surfaces of Solids," in 1829 ; and "On the Friction of Fluids," in 1831. To the British Association for the Advancement of Science he made two communications on the Quantity of Heat developed by Water when rapidly agitated, and presented to the same body an elaborate Report on the progress of Hydraulics as a branch of Engineering, published in the volumes for 1833 and 1834 ; also Reports on Railway Constants (1838), and on the Changes in the Channels of the Mersey (1855 and 1856). He is the author of various contributions on bridges, water-wheels, and other subjects of practical engineering, in the 'Transactions of the Institution of Civil Engineers,' in 'Weale's Papers,' and in Woolhouse's edition of 'Tredgold on the Steam-engine.' He also brought out a new edition of 'Buchanan on Machinery,' and added much new matter.

Mr. Rennie was elected a Fellow of the Royal Society in 1822 ; in 1845 he was nominated a Vice-President, and appointed Treasurer in succession to the late Sir J. W. Lubbock, which office he held till 1850. He was also a member of several foreign academies.

Mr. Rennie married, in 1828, Margaret Anne, daughter of the late Sir John Jackson, Bart., M.P., by whom he has left issue two sons and a daughter. Some time before his death he met with a severe accident, from the effects of which he never recovered.

Mr. Rennie was a man of gentle nature and quiet demeanour, in private as well as in public life greatly esteemed and respected.

HENRY DARWIN ROGERS was born in Philadelphia in 1809. At the age of twenty-one he was appointed Professor of Chemistry in Dickinson College, Carlisle, Pennsylvania, and afterwards to the Chair of Geology in the University of Pennsylvania. Then followed his superintendence of the Geological Survey of the State of New Jersey, residence at Boston, voyages to Europe, and (in 1857) acceptance of the Professorship of Natural History and Geology in the University of Glasgow, in which honourable post he died in May 1866.

Prof. Rogers published his Report on the Geology of New Jersey in 1835 : a year later he was intrusted with the important task of investigating and rectifying the geology of the great State of Pennsylvania, in which he spent several years of earnest labour. His brother, Prof. W. B. Rogers, was at the same time employed in the preliminary survey of Virginia, whereby some of the most important problems in American geology—the structure of the Appalachian mountain-chain, and, indeed, of half the continent of North America—were simultaneously worked out by two of the ablest observers of the day. The results of this survey, discussed in a joint Report, were communicated to the Meeting of the American Association of Geologists and Naturalists held at Boston in the summer of 1842, “with an eloquence and fascination of style never surpassed.” It placed the two brothers in an eminent position, recognized by the geologists of the world.

The anticipations formed on this occasion were fully confirmed by the final Report on the Geology of Pennsylvania, which was published at Edinburgh, with maps and sections, in 1858. To ensure the bringing out of this valuable work in a style commensurate with its importance, Prof. Rogers came to England, and, while residing in Edinburgh, made intimate acquaintance with many men of mark in the literature and science of Scotland. In society, and as a lecturer, his great and varied knowledge gave him an advantage which he exercised with graceful facility, and on favourite topics he would at times surprise and charm his hearers by bursts of eloquence.

Besides the works above mentioned, Prof. Rogers wrote papers and reports, which were published in the Reports of the American and of the British Association for the Advancement of Science, the Transactions of the American Philosophical Society, the Journal of the Boston Society of Natural History, in Silliman's Journal, the Edinburgh Philosophical Journal, and the Proceedings of the Geological Society. The long list of

subjects therein contained may be regarded as a memorial honourable alike to the author and to American science.

For a few years prior to his decease, Prof. Rogers was one of the editors of the *Edinburgh Journal* above referred to. His health being delicate, he spent his last winter in Boston, in company with his brother, and returned to Scotland but a short time before his death. He was elected a Fellow of the Royal Society in 1858.

WILLIAM PARSONS, third **EARL OF ROSSE**, was born at York, June 17, 1800, of a family which had been settled in Ireland from the time of Elizabeth, many of whom were distinguished in arms, at the bar, and in the Irish House of Commons. His father was one of the most eloquent persons of his day, and was the author of some works of value. Lord Rosse was educated at home by a private tutor, and when 18 years old entered Trinity College, Dublin. His career there was very successful both in science and classics, for he obtained all honours that were possible. He did not graduate there, though he answered for the degree; but in compliance with his father's wish went to Oxford, where he entered Magdalen College. At that time Oxford was far behind Cambridge in the cultivation of mathematical and physical science (to which he had now devoted himself), and he seems to have regretted this, though, no doubt, he did avail himself well of the instruction which he found. On leaving Oxford, he was returned for the King's County, which he represented in Parliament for eight years. He was not an active debater, though, whenever he spoke, he commanded attention; but in matters of business, and especially on committees, he had few equals. He then retired for a few years from political life to follow his favourite pursuit with more leisure, and discharge more completely the duties of a landed proprietor, in which he was exemplary. He was not exclusively devoted to astronomy or mechanics. In fact few minds of our day have grasped so wide a range of knowledge. He was a master of political economy, a greater one than many of its more renowned champions; for he brought to bear on it the sound common sense which was one of his chief attributes. He also devoted much attention to the great question of national education, and the loss of his authority and influence on that subject is deeply felt in Ireland at the present moment. He was a good chemist, would have attained a high position as a civil engineer, and possessed a large amount of military and nautical knowledge. As evidence of this it may be mentioned that he had formed the conception of armoured ships some years before the Crimean War, and had thoroughly investigated the problem. His calculations showed that vessels of no great tonnage could carry a sheathing of 4-inch plates which would be proof against the 32-pounder, the normal gun of the time. His elaborate memoir was sent into the authorities, acknowledged, and probably forgotten.

In 1836 he married Miss Field, the daughter of a Yorkshire gentleman,

in whom he found one worthy of himself. She sympathized in all his pursuits, mastered enough of astronomy to help him in his calculations, and entered into all his plans for the welfare of his tenantry and the good of her adopted country. And this last required no common strength of mind, for there was what might well startle a young Englishwoman. Kind and beneficent as her husband was, he was not less resolute in supporting the authority of law and putting down the murderous societies which were the terror and curse of that part of Ireland. This, of course, made him a mark for the assassin ; he knew his danger ; but the knowledge neither made him shrink from his duty, nor embittered his feelings against the misguided people who were conspiring against him. He held on his steady way, sustained by his calm determined courage, and perhaps by the fear inspired by his great physical power and consummate skill in the use of arms. For several years this danger existed, so that in his own park and at his telescope it was felt that all who could use weapons had better carry them. This continued till the terrible famine which ensued, crushed out under the weight of real misery the imaginary grievances of the agitators and showed men as they were. And none bore the test better than Lord Rosse, who applied to relieve the distress which surrounded him, not merely the power which belongs to habits of business and sound judgment, but something still more appreciable to common eyes ; for during some years he devoted nearly all the income of his Irish property to give the unhappy sufferers the means of existence. This told on their hearts ; and now also they began to be proud of his fame and to regard him as an honour to their nation, so that for the latter part of his life he ceased to be an object of hostility.

On the death of his father in 1841, he was elected an Irish Representative Peer ; in 1831 he had been appointed Lord Lieutenant of his County ; from 1848 to 1854 he was President of the Royal Society ; and in 1862 he was elected Chancellor of the University of Dublin.

His appearance promised a long life, but it was cut short by an accident so trifling that it was neglected till too late. A slight sprain of the knee produced, after some months, a tumour which was ultimately removed by a severe operation. The wound was slowly healing, but his strength sunk in the process ; and on October 31 he died as he had lived, patient and uncomplaining under his long and acute sufferings, gentle and considerate to all around him, and strong in Christian hope.

We think these personal details will interest the Society on their own account ; but they also may serve to illustrate the habits of thought and action which guided Lord Rosse in those researches which culminated in the magnificent instrument with which his name will ever be connected.

So early as 1826 his attention was directed to the improvement of the reflecting telescope, and it is instructive to trace the steps of his progress as recorded in his papers in Brewster's *Edinburgh Journal*, and those which appear in our *Transactions* for 1840, 1850, and 1861. They are

entirely original ; for there was no available information except the memoirs of Mudge and Edwards, which were only applicable to specula of four or five inches diameter. Lord Rosse's starting-point was the necessity of using speculum metal of the highest standard. For this he combined four equivalents of copper and one of tin : this compound is very brilliant and resists tarnish far better than if there be a slight excess of either ingredient. A striking example of this is a compound speculum polished in 1830, which lay neglected in his laboratory, yet a few years ago was still quite bright. Arsenic and other metals which have been recommended in small quantity, he tried, but preferred the simple alloy. This, however, is nearly the most intractable of all materials—harder than steel, more brittle than glass, friable, crystalline, and, worst of all, flying in pieces with any sudden change of temperature. In consequence, the common process of the founder does not avail here, except on a small scale ; and all large specula which had been previously made contained a larger proportion of copper than the above, that they might have the necessary toughness. Yet more, he shared the general belief that the polishing could only be done by hand, that it was essential to feel the nature of the contact, that therefore only small surfaces could be accurately figured. For both reasons he was led to build up a speculum of small pieces. His first attempt was very ingenious. He combined a central disk with annular zones two or three inches broad, and ground and polished them spherical. In such a surface, each zone is of shorter focus than those within it, and the resulting image would be indistinct. But by a fit adjustment, each, beginning at the centre, was drawn back till their foci coincided ; and the action of the compound was good even with an aperture of eighteen inches. Yet the complexity of the arrangement and its liability to change with temperature were weighty objections, and he was led by a new fact to devise another plan. In polishing these rings, he found the outer ones too large for hand-work, and made in 1828 a machine which gave a rectilinear motion to the polisher, while the speculum revolved slowly. This was only expected to produce a spherical figure, but it caused rings and other irregularities, which he saw would be corrected by adding a second eccentric, which, by giving a lateral motion to the polisher, changed its course into a curve which might be varied from a right line to an ellipse almost circular. This had the desired effect ; but on watching its action he saw that it would also give what was the great desideratum, a change of curvature from the centre to the circumference which could be varied at pleasure, and therefore could be made to give a true aplanatic figure. The machine so altered was employed through his whole life with only one important change, which was a means of setting the six-feet vertical while on the polishing machine, and testing it by a terrestrial mark. This was added in 1862, and very much facilitated the obtaining a perfect figure. He met the difficulty of obtaining a large speculum by making a strong frame of a peculiar brass which has the same expansion as fine speculum-metal, and soldering on its

front thin plates of the latter, cast on as large a scale as possible, and closely fitting them at the edges. From what has been said of the properties of this alloy, it may be judged how much mechanical skill the process required; but he succeeded in making a three-foot speculum, described in the Transactions for 1840. It was very light and strong, and defined perfectly, except that with large stars the diffraction at the joints produced four minute rays. For those below the fifth magnitude, and of course for fainter objects, this defect is insensible; and Lord Rosse believed that in this way only would it be possible to attain the extreme limit of telescopic vision. The construction is stronger than the solid speculum with a third of its weight; and the cellular distribution of the greater part of the mass enables it to assume the temperature of the atmosphere far more rapidly. During these experiments he was led to an important improvement in the casting of speculum-metal. When the melted alloy is poured into a mould the surfaces of it in contact with the mould harden, while the interior of the mass is still fluid; this cools in its turn, and in contracting exerts a powerful drag on the outer crust which gives way, and the whole is shivered. Besides, if the solidification is gradual the mass assumes a crystalline character, which gives it, when polished, a mottled surface. Lord Rosse met these difficulties by forming the bottom of his mould of iron, the sides of sand, and by leaving the top open: the metal in contact with the iron congealed almost in an instant, the sides of the speculum more slowly, as the sand is a worse conductor than the iron, the upper part remaining fluid longest; so that the contraction occurred chiefly at the back of the speculum, where it did no harm, while the front presented a layer of uniform and comparatively tough material. He found, however, that this layer is a little more liable to tarnish than that which is cooled slowly. The process is quite different from the chilling of cast iron, with which it has sometimes been confounded. All this was well; but now another difficulty was found. Copper in fusion absorbs a large quantity of oxygen, much of which it gives out on becoming solid, and speculum-metal appears to possess the same property. Owing to this it is always full of microscopic pores, and the escape of the gas when the alloy is cooled by contact with the iron, as it cannot rise through the viscid film which is formed, probably causes the bubbles and cavities which are found even when no air is entangled in the pouring. To give this gas a free escape was the obvious remedy, and that was effected by making the bottom of the mould of hoop iron, placed on edge and packed so closely that it retained the metal, but was pervious to gases. The plan was so successful that in 1840 he had finished a solid three-foot speculum, and had satisfied himself that even a six-foot was quite practicable.

He soon made the attempt; and succeeded in April 1842, in obtaining a perfect cast which, after being partly ground, was broken by the carelessness of a workman: two other failures are mentioned in his third paper; one of which, however, actually gave a disk more than seven feet diameter,

though of course too thin for use. This he regarded as a valuable result, for it showed the possibility of going far beyond the six feet, should such optical power ever be required. In these disasters his unfailing good temper and patience were not less admirable than his exhaustless mechanical talent. The whole mighty instrument was so far complete by February 1845, that on the 13th of that month he, his friend the late Sir James South, and another, saw in a lucid interval of clouds a few double stars and clusters.

Lord Rosse has given in the paper just referred to (1861) ample details of the telescope, both in respect of casting and figuring the specula and of the mechanism by which it is pointed to the heavens, and the observers enabled to use it with convenience and safety. In these we need not follow him beyond noticing the modest and undemonstrative character of the description, which gives but a very faint idea of the magnificence of what he had achieved. To those of us who have seen the telescope, and still more to the few who were present at the casting and polishing of the specula, it is but a lifeless shadow. They can never forget the machinery and furnaces that were installed in the towers and courts of the old castle whose walls still show traces of the sieges sustained in times of yore, the intelligence and discipline of the workmen whom he had formed from ignorant Irish labourers, and above all the matchless self-possession and unfailing resources of the master mind that guided all. In even beholding the instrument it is not easy to realize its colossal vastness; the machinery which moves it disappoints by its excessive simplicity, and it is not till one stands in the highest observing gallery and looks into the profound below, or over the surrounding country, that he obtains a true measure of its magnitude, and feels that it is sublime. It deserves notice that all this massive work was executed in Lord Rosse's laboratory, and that the whole had been so thoroughly considered that in no instance was it found necessary to deviate from the drawings which had been prepared.

With respect to its optical power, little need be added to what is said in the memoir of 1861. A more unfavourable location for it could hardly be found than the vicinity of the Bog of Allen; and its performance gives little earnest of what it could do in a finer climate and a few thousand feet above the sea. Hitherto it has also suffered from a disturbing cause peculiar to reflectors, and increasing very rapidly with their bulk. Besides the undulations of the air through which they look (which affect all telescopes), they have air-currents in their tubes caused by the great speculum being warmer than the atmosphere. The air in contact with the metal is heated, and rises along the upper side of the tube, while a stream of cold air replaces it, descending on the lower; and the eddies of the two cause strange wings and twirlings in the image. This goes on increasing as the night becomes colder, till sometimes all definition is lost. An example of this was given on March 5, 1845. The speculum was uncovered while cooler than the air, and was, of course, dewed. This did not dry off till

Regulus was passing ; that star was shown as a round point of intolerable light ; but as the night wore, the definition declined till ϵ Bootes came, which it only showed as two coloured flares, and Lord Rosse gave up further observing as useless. On October 20, 1848, under similar circumstances of uncovering the speculum, the blue star of γ Andromedæ was seen with 1500 divided a full diameter of the larger component, the colours blue and purple. The previous evening, after a longer exposure, the star looked elongated, and the division appeared only by glimpses. For this there seem but two possible remedies, to keep the speculum as near the temperature of the air as possible, and to make the tube of open work, so that the warmed air may escape as soon as possible. The first of these was not easily practicable with so huge a block of metal, though he thought it could be effected ; but the other, which was many years ago suggested by Sir John Herschel, he tried on the three-feet, and with such success that he resolved to apply a similar tube to the six-feet when it should require renewal. This will undoubtedly extend its good definition through a greater portion of the night, and make it more potent for the resolution of nebulae. But, even under average atmospheric conditions, its power is astonishing. No achromatic in Britain gives any adequate notion of the way in which it shows the moon, close contrasted double stars, or clusters like 13 Messier. Its chief employment, however, has been on nebulae, and the results which they have afforded are very remarkable. That it resolved a multitude of them which resisted all other telescopes was a matter of course ; but it also revealed in many of these strange bodies the existence of forms and forces completely at variance with our previous conceptions of celestial mechanics. Many of the observations are given in our 'Transactions' for 1850 and 1861 ; and it may suffice to indicate a few of their results. The most remarkable is the spiral arrangement, which seems to prevail very commonly in nebulae, and occasionally in clusters. Sometimes the spirals are as regular as the fire-curves of a pyrotechnic wheel ; sometimes, when seen obliquely, like the section of a snail-shell ; sometimes almost foreshortened into a ring ; occasionally there is a double system ; and in one or two instances the two sets turn in different directions. The dynamical condition which is implied by these appearances cannot be explained by any cosmical forces with which we are acquainted, and it is an object of the highest interest to science that they should be carefully watched for any signs of change.

It has also been ascertained that a remarkable class of nebulae, called Planetary from appearing like uniform circular or elliptic disks, have no existence ; they are shown to be systems of rings, sometimes very complicated, so that annular nebulae, of which only two were previously known in our hemisphere, are by no means uncommon. And thirdly, some information has been gained as to nebulous stars. These rare objects differ from ordinary stars in having a round atmosphere of some extent, and faintly luminous. This is not continuous, as had been supposed ; some-

times consisting of rings, sometimes separated by a dark interval from the central star. Such facts do not well accord with the old nebular hypothesis, but rather indicate a permanent state like that which last year prevailed for a few days in the noted star of the Northern Crown, in which a solid luminous nucleus is surrounded by an atmosphere heated to incandescence. It is far from improbable that such is also the case with many of those minute stars which this telescope reveals in thousands in bright nebulae, which it cannot entirely resolve. The stars and the nebula are evidently connected, yet as evidently of different nature. As an example may be taken the great nebula of Orion, in which, when the speculum is in fine order, it shows these lucid points as thick as dust, while yet there is manifestly a different source of light. In this case the nebula seems brighter than the stars; and so Mr. Huggins has found that the nebular spectrum alone is visible. On this, and many similar questions, each new observation opens an ever-widening field of inquiry; and it is permitted to us to hope that the unrivalled power of this mighty instrument will still be exerted in that field, and that the son and successor of him whom we so deeply regret will follow his example in this, as in all else for which he was honoured and loved.—T. R. R.

JAMES SMITH, of Jordan Hill, near Glasgow, was born in Glasgow on the 15th of August, 1782. He was the eldest son of Archibald Smith, Esq., an eminent West India merchant in that city, and of Isabella Ewing, who died a few years ago in her 101st year.

Mr. Smith was educated at the Grammar School and University of Glasgow. He was for many years a sleeping partner in the West India House of Leitch and Smith in that city, but never took any active part in business. His tastes directed him to literary and scientific pursuits and the fine arts. He was in early life an enthusiastic book collector, particularly in the department of early voyages and travels, of which he has left a large and valuable collection. His love of yachting was one of the most prominent features in his life, and it was lifelong. His first cruise in a yacht of his own was in the year 1806; his last in the year 1866. He was one of the earliest members of the Royal Yacht Club, now the Royal Yacht Squadron; and was one of the earliest and latest Commodores of the Royal Northern Yacht Club.

Most of Mr. Smith's scientific and literary researches were connected with his love of yachting. His earliest paper in any scientific publication was a notice in the Transactions of the Royal Society of Edinburgh of an undescribed vitrified fort, in the Burnt Isles in the Kyles of Bute, discovered by him in accidentally landing from his yacht. In geology, the science to which he was peculiarly attached, his attention was early directed to the question as to the relative position of the land and sea which had subsisted at remote geological epochs; and the west of Scotland, the district in which he resided, offered admirable opportunities for his inquiries. In

the sandstone cliffs between Gourock and Largs, in the trap-dykes of Cumbræ, and, indeed, nearly all round the coasts of the Firth of Clyde, there was unmistakeable evidence of the slow and long-continued action of the sea; and the beds of fossil shells found at various elevations, and remote from the present coast, obviously demonstrated that a great part of Scotland had, at a comparatively late geological period, been covered by the sea. In pursuing his researches, Mr. Smith soon perceived the importance of carefully comparing the shells of the living species of mollusca in European and more northern seas with those found in the superficial deposits of Scotland now known as post-pliocene or glacial drift, and with the forms occurring in raised beaches and other later formations. These researches he conducted by dredging explorations from his yacht. In this investigation he discovered that a large proportion of the mollusks whose shells are found in these deposits, but do not now exist in the Clyde, are still to be found living in the arctic seas. This led him to the conclusion announced to the Geological Society in 1836, of the existence, before the present state of things, of a colder climate than the present—a conclusion which, though opposed to what geologists had previously believed, is now universally accepted. In continuing his investigations, Mr. Smith found reason to distinguish the deposits in question into two, in the older of which a considerable proportion of shells and other remains had belonged to animals now extinct in our latitudes, but in the later of which, belonging to a more recent period, every one of the shells has been found as species now existing, though some of them only in the arctic seas. This is the period of long repose of the land, at a depression of about 40 feet below the sea, which now has left the modern shores of the west of Scotland fringed, at an elevation of 40 feet, with that old sea-cliff which is so marked a feature in its scenery.

From 1839 to 1846 the health of members of his family caused Mr. Smith to reside successively at Madeira, Gibraltar, Lisbon, and Malta, and valuable geological papers on each of those localities attest the zeal with which he pursued his favourite science.

His residence at Malta was the occasion of the remarkable series of investigations by which he is best known in literature and theology. These were first published in 1848 in 'The Voyage and Shipwreck of St. Paul, with Dissertations on the Life and Writings of St. Luke, and the Ships and Navigation of the Ancients.'

The part of the volume which relates to the voyage and shipwreck of St. Paul has been accepted by all critics and theologians who have since written as conclusively settling all doubtful and contested questions as to the narrative. This work is a remarkable instance of originality, ingenuity, and sagacity, and of the application of practical knowledge of seamanship and geology to the elucidation of a point of literary and theological interest.

The minute study of the writings of St. Luke, to which Mr. Smith was

thus led, conducted him to a view on the much-contested question of the connexion of the first three Gospels, which was first published in the 'Dissertation on the Life and Writings of St. Luke,' to which we have referred, and which was afterwards worked out in greater detail in a separate 'Dissertation on the Origin and Connexion of the Gospels,' published in 1853. On this subject Mr. Smith's view, which differs from any previously taken, though not accepted to the same extent as his conclusions respecting the voyage of St. Paul, has had many followers. He was engaged in the collection of materials for a more extended dissertation on the same subject when interrupted by his last illness.

Mr. Smith was a member of many scientific societies—of the Royal Society, the Geological Society, and the Royal Geographical Society of London, and the Royal Society of Edinburgh. He was president of the Geological Society of Glasgow and of the Archæological Society, and was for many years president of the Andersonian University in that city, and was unwearied in his exertions for its benefit, and for the improvement of its valuable museum. The date of his election into the Royal Society is Dec. 23, 1830.

Mr. Smith enjoyed vigorous health till the spring of last year, when a slight stroke of paralysis enfeebled his body, without affecting his mind. A further attack towards the close of the year terminated in his death at Jordan Hill on the 17th of January, 1867.

Mr. Smith was married in 1809 to Mary Wilson, granddaughter of Dr. Alexander Wilson, Professor of Astronomy in the University of Glasgow. By her, who died in 1847, he had nine children, of whom three survive,—Archibald Smith, Esq., F.R.S., late Fellow of Trinity College, Cambridge, a member of the Chancery Bar, and two daughters.

SIR JAMES SOUTH, born in October 1785, was the eldest son of an eminent Pharmaceutical Chemist resident in Southwark. Educated at a private school, he acquired a fair knowledge of Greek and Latin, and such elementary instruction in mathematics as was current in those days. On leaving school he commenced the study of surgery, which he chose as a profession; combining with it that of chemistry, in which he was no ordinary proficient. In due time he became a member of the College of Surgeons, and rose rapidly into extensive practice. Sir A. Cooper, whose dresser he had been for a time, believed that if he had persevered he would have been one of the most eminent surgeons of his time. But a different fate was before him. While yet a boy his curiosity had been excited by a singular erection on the roof of a house near his father's, and he contrived to get acquainted with its owner. This was Huddart, an engineer of distinguished talent; known, among other inventions, by machinery for making ropes in which every fibre bears an equal strain. The structure was a dome for containing the equatoreal which afterwards became famous by his and Sir John Herschel's observations of double stars. The ideas

which he got from his visits to Huddart were not lost ; and as soon as he was able, he procured a 6-inch Gregorian with which he observed eclipses, occultations, and looked at double stars. Observing soon became a passion ; and when, in 1816, his marriage with a lady who brought him a considerable fortune made him no longer dependent on his professional work, he resolved to devote himself to astronomy. He began by constructing at his house in Blackman Street a magnificent observatory. After the death of Huddart he purchased the equatoreal which had been his first inspirer ; a fine transit instrument, which he described in the Philosophical Transactions for 1826, was soon added ; and a circle was in progress. His zeal for astronomy and his personal character won the regard of such men as Davy, Wollaston, Kater, Babbage, Baily, the two Herschels, and, at a later period, Faraday and Lord Rosse ; and his house was a centre of scientific reunion. He took an active part in the formation of the Astronomical Society ; and, in conjunction with Baily, exposed the defects of the ‘ Nautical Almanac ’ so effectually, that after some years of discussion it was brought to its present excellence in accordance with the recommendations of a committee, of which he was the chairman. From 1821 (when he became a Fellow of the Royal Society) till 1824 he worked with Sir John Herschel in forming the Catalogue of 380 double stars which (with a description of the equatoreal) appears in the Transactions for 1825. For this they obtained conjointly the medal of the Institute, and till the publication of Struve’s Dorpat Catalogue it was quite unrivalled. During its progress it became too evident that the smoky atmosphere of the Borough was ill suited for delicate observations ; and he transported another equatoreal to Passy, near Paris, where he expected to find a purer sky. He resided there more than a year, enjoying the society of those “ men of renown,” of whom the chiefs were Arago, Humboldt, and, above all, Laplace, whose scepticism about the orbits of double stars he had the pleasure of removing by *showing* him the angular motion of 70 Ophiuchi, the components of which were then near their least distance. The fruits of this sojourn appear in the Transactions for 1826 as an additional catalogue of 458 double stars, for which, and his paper “On the Sun’s Right Ascension,” he was awarded the Copley medal of that year and the gold medal of the Astronomical Society. On his return to England he purchased a property at Kensington, where he was free from smoke, not foreseeing (though many people who ought to have known better supposed him to be an Astrologer) that he should live to see it in the heart of a dense population. There, of course, he built a magnificent observatory, the finest private one probably that ever existed. It was now increased by the purchase of Groombridge’s meridian-circle, to which he had eight additional microscopes applied by its maker, and by a valuable clock, the gift of the King of Denmark. By this time the labours of Guinand on optical glass had made it possible to construct object-glasses of a size till then unattainable ; and he determined to procure one of the highest power, and pursue with his whole energy the career on which he

had so successfully entered. For this work he was highly gifted; he had a keen eye, a steady hand, great power of bearing fatigue and want of sleep, prompt decision in catching a bisection, and boundless enthusiasm. Fraunhofer, to whom he applied in the first instance, declined giving him an object-glass without also supplying its equatoreal. It would have been a happy thing for him had he accepted this proposal; but he had no faith in any instrument maker but Troughton, whom he worshipped with all the intense devotion of his impulsive character. He looked elsewhere: Cauchoix had completed a 12-inch object-glass, about which, in 1829, he was chaffing with the French Government; South heard of it, went over to Paris, tried it, paid the optician the price which he demanded, and started with it next morning on his way to England, to the great disgust of Arago that it was lost to France. But it was a fatal acquisition. Troughton was of course charged with the construction of the equatoreal; and a dome for containing it was also commenced. Unhappily, both of them were planned without much respect for the elementary principles of engineering, the first especially; and though Mr. Babbage and others pointed out to him its utter weakness, he merely answered, "It is designed by Troughton." He had no knowledge of mechanical science, and had unlimited faith in Troughton's infallibility. As was foretold, the instrument was a failure; and though many attempts were made to correct the inherent vices of its framing, they were only partially successful. The result was a deadly quarrel between the two friends (which perhaps might have been healed but for the intervention of other personal animosities), and a litigation, which after a run of four years was decided in a way unsatisfactory to both parties, most so to South. The dome was also a failure; in general it required four or five men to move it; sometimes it stuck fast! The loss of full £8000 thus spent without any useful result was itself a misfortune; but it was as nothing in comparison of the evil influence which these transactions exerted on his character. The feeling that his confidence had been misplaced, that the friendship which had been his ruling passion, and which he still cherished, was changed into bitter hate, made him suspicious and irritable; and he lost that reliance on the truthfulness and honesty of others, without which life becomes a desert. By degrees this left him in an isolation from many old and true friends; and also, as a necessary consequence, deadened his love of science, which, like all other good things, is strengthened by sympathy. And he had no longer a definite pursuit; he could not resolve to adopt any practicable form of equatoreal, though Lord Rosse offered to design and even to make one for him; and during the years that were wasted, the harvest of double stars which he had hoped to reap was gathered by Sir J. Herschel, the two Struves, Bond, and others. This object-glass, while in his possession, made only one discovery, the sixth star in the trapezium of Orion; and remained useless till he gave it to the Dublin Observatory in 1862, when Lord Rosse was elected Chancellor of that University. In the hands of Dr. Brünnow

it will doubtless be well employed. South, however, still worked with his meridian instruments; among other things he observed a considerable number of stars with the Groombridge circle, and the results are probably valuable, as each observation was direct and reflected on the same night with twelve microscopes. He for some years carried on an elaborate series of experiments on clocks to ascertain their performance *in vacuo*, the air's resistance to pendulums, the influence of various modes of suspending them, and the effect of screens in their vicinity. These are, it is believed, all preserved, and may perhaps be published. Another object to which he devoted much research, was the disturbance which might occur to an observatory from the vicinity of a railroad; and an account of his observations at Watford respecting it, which appears in our Proceedings for 1863, was his last contribution to science. For some years before his death his hearing and sight were almost entirely lost, and this helpless condition was made more afflicting by much bodily suffering, from which he was released on October 19, 1867. He was knighted in 1831 by William IV., with whom he was a favorite. He was one of the original Visitors of Greenwich Observatory, and a Member of the Astronomical Society, the Linnean, the Royal Society of Edinburgh, Royal Irish Academy, and of several others.—T. R. R.

JOSEPH TOYNBEE, well known as an eminent Aural Surgeon, was distinguished for the remarkable industry with which he strove to give a scientific character to the branch of medical practice to which he had devoted himself. He was born at Heckington, in Lincolnshire, and died at his professional residence, in London, on the 7th of July, 1866, in the fifty-first year of his age.

After completing his education at Lynn, Mr. Toynbee was articled to Mr. Wm. Wade, of the Westminster General Dispensary, and afterwards became a pupil at St. George's Hospital. Having early exhibited a taste for anatomical pursuits, he was, whilst still young, appointed Assistant Curator in the Museum of the Royal College of Surgeons. Soon after this, his love of anatomical inquiry displayed itself in a microscopic investigation, the results of which were embodied in a paper read before the Royal Society, and published in the Philosophical Transactions for 1841, entitled "Researches tending to prove the Non-vascularity of certain Animal Tissues, and to demonstrate the peculiarly uniform mode of their Organization and Nutrition." This memoir, though, when viewed by the light of recent histology, of but limited scope, was a real contribution to science at the period of its publication.

In his subsequent labours, Mr. Toynbee turned his attention exclusively to the Anatomy, Physiology and Pathology of the Organs of Hearing. Thus he contributed to the Meetings of the Royal Society four papers, bearing the following titles:—1. "On the Structure of the Membrana Tympani of the Human Ear" (1850). 2. "On the Function of the Membrana Tympani, the Ossicles and Muscles of the Tympanum, and of the

Eustachian Tube in the Human Ear, with an Account of the Muscles of the Eustachian Tube, and their Action in different Classes of Animals" (1852). 3. "On the Muscles which open the Eustachian Tube" (1853). 4. "On the Mode in which Sonorous Vibrations are conducted from the Membrana Tympani to the Labyrinth in the Human Ear" (1859). The first of the above-named memoirs was published in the *Philosophical Transactions* for 1851; whilst, of the other three, records will be found in the Society's 'Proceedings.'

In investigating the pathology of the ear, Mr. Toynbee proceeded by collecting a very large number of specimens of the human temporal bones and their contained parts, both healthy and diseased. The morbid specimens, said to number nearly 1700, were described by him in numerous contributions to the Royal Medical and Chirurgical Society, to the Pathological Society, and to various journals. Besides this, he published an interesting 'Descriptive Catalogue of Preparations illustrative of Diseases of the Ear in his Museum,' and also a systematic work on 'The Diseases of the Ear; their Nature, Diagnosis and Treatment,' besides occasional "Lectures" on the same subject.

He was for some time Surgeon to the St. George's and St. James's Dispensary, and was engaged in the general practice of Surgery; but, whilst retaining the title of Consulting Surgeon to the above-named Institution, he soon devoted his time and energy to Aural Surgery alone, in which department of his profession he gradually acquired a wide-spread reputation, his practice as an Aurist ultimately becoming very large. He was Consulting Aural Surgeon to St. Mary's Hospital, and to the Asylum for the Deaf and Dumb.

Mr. Toynbee's premature and sudden death was caused by the inhalation of chloroform, on the possibility of introducing which powerful agent into the tympanic cavities through the Eustachian tubes he had long been experimenting. He was found dead on his sofa, in his consulting-room in Savile Row, with cotton-wool over his face, and a chloroform bottle, his open watch, and various memoranda of experiments lying near him. It is but just, and it may be useful, to remark, that, while he doubtless fell a sacrifice to his experimental zeal, the deplorable event is in all probability to be ascribed to the extreme imprudence of inhaling chloroform when alone and unattended.

The subject of this brief notice was a man of enlightened intellect, quick temperament, and energetic habits, of enlarged views, cultivated taste, and benevolent disposition. In connexion with the St. George's and St. James's Dispensary, he founded a Samaritan Fund to provide the sick poor with bread, soup, wine, flannels, and coals, and also the means of ventilating their apartments. He was not only an active Treasurer to the Medical Benevolent Fund, but was an anonymous donor to it of the munificent gift of £500. He advocated the establishment of local museums, libraries, and institutes, the better education of

the working classes, and the improvement of the dwellings of the poor; and, at one time, spent much time and money in furtherance of such objects and purposes. He was vigorous and lively in both his professional lectures and his more popular "lecturettes," as he himself preferred to call them. His neighbours and friends at Wimbledon, where he latterly resided, fully appreciated his excellent public and social qualities. The date of his election into the Royal Society is March 10, 1842.

ROBERT WARINGTON was born on the 7th of September, 1807, at Sheerness, where his father, Thomas Warington, who was a victualler of ships, then resided. He was educated at Merchant Taylors' School, and, being intended for a land-surveyor, he was, on leaving school, set to learn that business, but, after a few months, abandoned it in favour of chemistry, which he studied as the house pupil, and subsequently, in 1822, the articulated apprentice of Mr. J. T. Cooper, then a well-known lecturer and manufacturing chemist.

On the opening of the London University (now University College) in 1828, Mr. Warington, having served his time with Mr. Cooper, was chosen by the Professor of Chemistry, Dr. Edward Turner, to be his assistant. In that capacity he continued at the College for three years, during which period he communicated to the *Philosophical Magazine* his first published research, entitled "Examination of a Native Sulphuret of Bismuth."

In 1831, Messrs. Truman, Hanbury and Buxton, desiring the services of an able young chemist in their great brewing establishment, engaged Mr. Warington, on the recommendation of Dr. Turner, and with them he remained till 1839. His connexion with the brewery did not prevent his independent pursuit of chemistry, and during this period he contributed papers to the *Philosophical Magazine*, "On the Establishment of a System of Chemical Symbols" (Sept. 1832), and "On the Action of Chromic Acid upon Silver" (Dec. 1837).

On the death of Mr. Hennell in 1842, Mr. Warington was appointed Chemical Operator to the Society of Apothecaries, a position he continued to hold till about a year before his death. His professional engagements now became numerous, and he was much employed as a scientific witness or adviser in important cases coming before the Courts of Law.

Mr. Warington's scientific activity manifested itself in various ways. In 1841 he took an important part in the establishment of the Chemical Society, and became one of the original Secretaries, which post he held for ten years. He was one of the promoters of the Royal College of Chemistry; and he took part in the formation of the Cavendish Society, and held the office of Secretary for three years. He was Chemical Referee of four of the principal gas companies of the metropolis. He served as Juror in the Chemical Section of the International Exhibition of 1862, and was

appointed to a similar office in the Paris Exhibition of 1867, but was unable to discharge the duty.

Mr. Warington's scientific acquaintance with Pharmacy, and the large experience he had acquired in the practice of the art, led to his being employed in revising the translation of the London Pharmacopœia, left unfinished by Mr. Phillips, and in aiding in the construction of the Pharmacopœia of 1851. For a like reason he was consulted by the Committee appointed to prepare the British Pharmacopœia of 1864, and undertook a still more important share, along with Mr. Redwood, in the preparation of the British Pharmacopœia of 1867, although his failing health allowed him but partially to perform his task.

Amid these varied labours of his active and useful life, Mr. Warington continued to furnish numerous contributions on chemical and pharmaceutical subjects, to the *Memoirs and Quarterly Journal of the Chemical Society*, the *Philosophical Magazine*, and other periodical works. To the *Transactions of the Microscopical Society*, of which he was an efficient member, he contributed several papers, and he was the inventor of a portable microscope, which has been favourably spoken of.

A subject of more general interest, which furnished an agreeable and instructive study to Mr. Warington for many years, was the mode of life of aquatic animals and plants preserved in the aquarium; and especially the maintenance in a limited quantity of unrenewed water of the chemical conditions necessary to their existence, through the mutually compensating operations of animal and vegetable organisms upon the medium they inhabit. The results of his observations were published, from time to time, for the most part in the '*Annals of Natural History*,' and also furnished the subject of a Lecture delivered by Mr. Warington at one of the Friday Evening Meetings of the Royal Institution. The latest yield of these long-continued researches which he lived to make known, forms the subject of a valuable and interesting paper "*On some Alterations in the Composition of Carbonate-of-Lime Waters, depending on the Influence of Vegetation, Animal Life, and Season*," communicated to the Royal Society within a month of his death, and published in the '*Proceedings*' of December 1867.

In 1835 Mr. Warington married Miss Elizabeth Jackson, by whom he has left a family. He was elected a Fellow of the Royal Society in June 1864; he died at Budleigh Salterton, in the county of Devon, on the 12th of November 1867.

Mr. Warington was remarkable for his varied taste and constant activity as an observer; he may be said, indeed, to have passed from one subject to another with too great a facility, and consequently his completed investigations bear but a very small proportion to the number of subjects he had continually under examination. He was of an exceedingly cheerful and genial disposition, and a man of simple unaffected piety.

THE REVEREND WILLIAM WHEWELL, D.D., late Master of Trinity College, Cambridge, and a Fellow of this Society, was born on the 24th of May, 1794. His career affords one more, and a very striking illustration in addition to those which the biographical annals of our country so abundantly present, of what may almost be regarded as the normal progress from an origin altogether devoid of external advantages, and in the humbler walks of life, to eminence and distinction as well as social position, wrought out by innate talent rendered effective by energy and persevering application, and sustained by high moral qualities. Beyond his immediate parents, little is known of his family. His father, a man of probity and intelligence, pursued the calling of a joiner or house-carpenter in Lancaster. His mother appears to have been a person not only of excellent principle and good sense, but of some considerable mental culture. Their family consisted, besides himself, of a brother who died at an early age, and three sisters. His own health in early youth was feeble, and afforded no prognostic of the robust frame and stalwart vigour which so strikingly characterized his manhood. On the other hand, from his earliest years he manifested a remarkable fondness for reading, and exhibited such general promise of future ability, as induced his parents to remove him from the Grammar School in Lancaster, where he received the first rudiments of instruction, to that of Heversham, where he might obtain the advantage of an Exhibition for admission to Trinity College, the Vicarage of Heversham being in the gift of that body. This he secured, and was in consequence admitted at that College as a sub-sizar in the October term of 1812, and was subsequently elected as a full, or foundation sizar, and obtained a scholarship. In 1816 he graduated as second Wrangler and Smith's Prizeman, the first honours being carried off by a competitor (Mr. Jacob of Caius College) by whom to have been surpassed could no way be considered as a defeat. His undergraduateship, meanwhile, had been distinguished by obtaining the Chancellor's prize in 1813 for the best English Poem on the subject of Boadicea—a spirited production, which may be read with pleasure as something beyond a college exercise, and evidencing that strong vein of poetical talent which showed itself on many subsequent occasions.

In the year following his graduation as B.A., he was elected a Fellow of his College with whose interests and glory he ever afterwards considered his own as identified, and was very soon engaged in lecturing in Mathematics as assistant tutor, and subsequently in 1823 as full tutor of one of the "sides" of that numerous establishment, the tutor's chair on the other "side" being filled by Dr. Peacock, afterwards Dean of Ely. This important office he filled during the ensuing sixteen years, being joined in the performance of its duties during the last six with the Rev. Charles Perry, afterwards Bishop of Melbourne. Soon after taking his Master of Arts' degree, he entered into Holy orders, and in

due course graduated as Doctor of Divinity. He accepted no College living, however, or special cure of souls—not from any want of appreciation of the importance of the ministerial office, or doubt of his own aptitude for its exercise, but from a conscientious persuasion that his true sphere of utility would be found in the entire devotion of his powers to the furtherance of the objects of the University as a place of education, and to the improvement of its system of instruction in those great branches of mental culture in which it was beginning to be felt at that epoch that such improvement was not only possible, but largely needed. Such prospects we have seen amply realized; but it should not be forgotten for the credit of that illustrious establishment, that the movement in advance then making originated within itself, and was in no way forced upon it by any pressure from without. Thenceforward, then, his career may be considered as identified with the great cause of University improvement, and in a larger and more expansive point of view with that of philosophical, moral, and religious *culture* in the widest and best acceptance of the words.

During the period when he was pursuing his studies at Cambridge, the mathematical department of the University *curriculum* was in what might be called a transitional state. A perception had begun to be entertained of the absolute necessity of including within its range a knowledge of those powerful methods of investigation so familiar to the Continental mathematicians, but which could hardly be said to be known in England, and which at Cambridge had by some even been regarded with dislike, as innovational. In this latter feeling, in common with most of its younger members, he was far from participating, but on the contrary was only desirous to forward the movement which he saw commencing.

About the period when he entered on his tutorial duties, a very general sense had come to be entertained of this necessity; but a great obstacle to the introduction of an improved course of mathematical reading existed in the absence of elementary works in our own language adapted for the purpose of university teaching, in which the principles of the analytical methods as applied to physical subjects were exhibited, and a yet greater in the utterly unphilosophical and inadequate mode of treatment in what were termed “the branches” current in the University. The primary difficulty had been removed by the translation by Peacock and his coadjutors of the treatise of Lacroix on the differential and integral calculus published in 1816, and followed by a copious collection of examples illustrative of its application to problems of pure mathematics and the theory of curves in 1820. But the want of *readable* elementary works in all the branches, and especially in that of dynamics, such as might, as it were, break the abruptness of the transition, and bridge over the interval between the modes of treatment of that subject in the ‘Principia’ of Newton and

in the modern analytical processes, was severely felt. Accordingly we find him in the period of his tutorship, from its very commencement, engaged in the production of a number of elementary treatises devoted to this object, and to conveying the primary principles of mechanical philosophy in a sound and logical form, as well as to affording an insight into the modern ways of handling them, such as his 'Elementary Treatise on Mechanics' (1819); his 'Treatise on Dynamics' (1823); his 'Introduction to Dynamics,' 'First Principles of Mechanics,' and 'Treatise on the free motion of a Point and on Universal Gravitation' (1832); his 'Elementary Treatise on Mechanics,' and 'Analytical Statics' (1833), and his 'Mechanical Euclid' (1837). Of these works, the first mentioned has been considered by one excellently qualified to judge of its merits as "a work of great value, and very far in advance of any then existing text-book, for the clearness and correctness of its treatment of bodies in contact, and in the precision with which the assumptions involved in the laws of motion and the composition of forces are stated, and illustrated." At the end of the last named (the Mechanical Euclid) is attached a section "on the Logic of Induction," in which the leading idea which forms the foundation of his great work on the Philosophy of the Inductive Sciences, published three years later, viz. that Induction consists in *superinducing* upon an assemblage of observed phenomena, a conception—the creation of the mind, which is not *in* the phenomena, but which serves to bind them under a common aspect, and so give them an ideal unity—is anticipatorily introduced.

By these works, and by the influence which, as moderator in the years 1820, 1828, and 1829, he was enabled to exercise on the course of the examinations for degrees, he contributed materially to that improvement he so much desired to see established in the mathematics of the University.

It would give but a very inadequate idea, however, of the extent of his reading and of his extraordinary intellectual progress at this period of his life, to measure them by these productions. A more wonderful variety and amount of knowledge in almost every department of human inquiry was perhaps never in the same interval of time accumulated by any man; embracing not only Mathematical and Physical Science in all its forms, but extending over Classical and Continental literature, Metaphysics and History, Ethics, Social and Political Economy, together with Botany, Architecture, Engineering, and a host of other subjects—and that not by merely a general and superficial acquaintance, but one which an exact and conscientious application such as most men devote to some favourite branch of study, alone can give. Nothing short of such a store of precise and varied information could have qualified him for the production of those great works on the History and on the Philosophy of the Inductive Sciences which have placed his name among the brightest in the annals of our Philosophy, and the former of which appeared in

the year 1837, during the continuance of his tutorship, and the latter about three years later. These works were preceded (in 1833) by his Bridgewater Treatise ‘On Astronomy and general physics considered in reference to Natural Theology.’ But that a great change in his views as to the origin of our fundamental axioms must have taken place between the production of these and the last-mentioned work, may be inferred from a remarkable passage in that Treatise*, in which he distinctly refers the origin of even the axioms of Mathematics to experience, *i. e.* to a slow process of inductive observation, growing with our growth, and not to any innate *à priori* intuition.

Dr. Whewell was one of the founders of the Cambridge University Philosophical Society, whose initiation dates from November 15, 1819, its first Meeting for the election of Officers being held on December 13 of that year, when Professor Farish was chosen President, and Dr. Whewell was placed on the list of its Council. In 1820 he contributed his first paper to its Transactions, “On the position of the Apsides in orbits of great excentricity.” To the Transactions of this body he continued to contribute, up to within a short period of his death, papers on a great variety of subjects,—on Dynamics, on Mineralogy and Crystallography, on Logic and Philosophy (more especially on the Platonic philosophy of ideas), and on the mathematical exposition of the doctrines of Political Economy, in which the formulæ embodying the results of those doctrines, as applied to questions of supply and demand, price, currency, &c., are derived from what he cautiously terms “The Equilibrium Theory” in analogy to the “Equilibrium Theory” of the Tides, distinguishing very justly between this and their true or dynamical theory, which takes account of momentary changes in the amount and incidence of the acting causes, and allows for the time requisite to enable them to work out their effects—a distinction of the most important kind, and one which goes to exhibit all the *quantitative* conclusions deduced in this science on the other hypothesis as tentative and provisional.

During the summers of 1826 and 1828 he took part with Mr. Airy in a series of experiments for ascertaining the mean density of the earth, by comparing the rates of the same pendulum in deep mines and at the surface. These experiments, made in the Dolcoath Mine, near Cambourne, in Cornwall, were excellently planned, and, so far as they went, admirably conducted; but by a singular fatality were in both instances cut short in their progress, and frustrated of their result, by accidents which could not have been foreseen and provided against—in the one case by the combustion in mid-air (from some cause never explained) of the basket containing the pendulums and other apparatus, in the act of raising them from the bottom of the mine to the surface—in the other, by the mine itself becoming deluged with water, owing to the

* Bridgewater Treatise, p. 336, ch. ix. *et seq.*

sudden subsidence of a mass of rock "many times as large as Westminster Abbey." These failures, however, are the less to be regretted, as, had they not occurred, the third and successful attempt made by the Astronomer Royal in 1854, in the Harton Coal-pit, near South Shields, at a greater depth, and with the immense advantage of electric communication between the clock above and the pendulum below, might never have been undertaken.

In 1828 Dr. Whewell was chosen Professor of Mineralogy, as the successor of Professor Clarke, a position for which he had prepared himself by a residence in Germany, under the instructions of Professor Mohs. The subject, especially its crystallographical department, had previously, however, attracted much of his attention, as is evinced by his elaborate memoir "On a general method of calculating the Angles made by any planes of Crystals," communicated in 1824 to the Royal Society (of which so early as 1821 he had become a Fellow). Several papers on the same department of Mineralogical Science were also communicated by him to the Cambridge Society in 1822, 1827, and 1828. This appointment, however, he held only for four years, and resigned it in 1832, when he was succeeded by Professor William Hallows Miller.

In 1827 he became a Fellow of the Geological Society, of which, such was the general sense of his proficiency in that science, in 1838, he was elected to the office of President. To this Society he communicated (in 1847) a paper on the distribution of the Scandinavian boulders. In the Meetings of the British Association, too, he took a lively interest, and was President of that body in 1841. He was the originator, or one of the originators of that system of Reports on the present state and progress of the several branches of science, which have from time to time been so usefully and instructively published in their annual Proceedings. In 1831 we find him writing to a friend on this subject. "The advice I gave them (the managers of the York Meeting) was to this effect: that the meeting should select eminent persons in each department of science, and beg them to make, by the next annual meeting, reports as to the present condition of their respective provinces, and the points where research will apparently be most useful; that the purport of these reports and the degree of interest which they may excite should be the guide and basis of future operations of the Association, if it continue; and that, at any rate, such collection of reports, if it can be procured, be printed—by which means their Wittenagemote will not have met in vain." This idea being acted on, he himself contributed from time to time, Reports on the Tides and on the Mathematical theories of Heat, Magnetism, and Electricity.

The subject of the Tides engaged a large portion of his attention, and gave occasion for a series of researches on the progress of the Tide-wave in different regions of the ocean, communicated to the

Royal Society, and printed in their Transactions from 1833 to 1850. His labours on this branch of physical inquiry were distinguished in 1837 by the award of one of the Royal Medals. In point of general result, these investigations may be considered as having afforded a clear and satisfactory view of the Atlantic Tides, while those of the Pacific (to which only a single memoir—the 13th in order—is devoted) remain still, in many of their features, enigmatical, and perplexed with difficulties which can only receive their elucidation from a long series of discussion carried out on the same principles, and based upon far more extensive observational data than he then commanded, or than we yet possess. One of the most curious and unexpected results of these inquiries is, that there exist two points in the North Sea, one between Harwich and Amsterdam, the other near the entrance to the Baltic, in which there is no rise and fall of the tides. Of these points, thus first theoretically indicated, the former has been subsequently verified by observation; the other does not appear to have been sought for.

With exception of this series of researches, his labours as a direct contributor to Physical Science may be considered as having terminated with his acceptance of the professorial chair of Moral Philosophy (or, as it is officially designated, of Moral Theology and Casuistry) in 1838. The work of Paley on Moral Philosophy, in which the basis of moral obligation is made to rest on expediency (taken in its largest sense, as that which on the whole, and on a broad and general view of human relations, is most conducive to human happiness), was at that time the text-book followed in the University. This view of the foundation of morals was, however, peculiarly distasteful to him, and the whole tenor of his teaching on this subject was devoted to the expulsion of what has been termed the utilitarian theory of morals, and the substitution for it of the inward teaching of a divinely implanted conscience, enlightened and guided by reason—obeying in this, as in his views of Physical Science, that strong leaning towards the Platonic or ideal system of philosophy which refers all our knowledge, in so far as it assumes a regular and systematic form (as other than the recollection of individual facts), to innate and primarily implanted conceptions coordinated with facts by the operation of the mind. Thus, as in geometry we coordinate our perceptions of the external world in accordance with our innate conception of Space—so, in this view of morality we coordinate our judgment of human action, and of our own emotions and desires in reference to the innate and originally implanted idea of Right; assuming that its fundamental axioms and leading propositions have found their utterance (though hitherto imperfectly, and only in the most usual and simplest cases of their application) in those positive laws which regulate the conduct of man towards his fellows in all civilized communities. These views are embodied in his sermons on the Foundation of Morals, his

'Elements of Morality,' his 'Lectures on the History of Moral Philosophy in England,' and more especially his 'Lectures on Systematic Morality' (1846). The two views are no doubt ultimately reconcilable, or rather essentially those of one body of truth approached from different ends of the vista: since if it could be shown that any *legitimate* conclusion as to moral duty drawn from the *à priori* system were incompatible with the production of general happiness and wellbeing, such conclusion could not but be deemed an insuperable objection to its truth; and since the ultimate reference to the enlightenment and guidance of reason (as distinct from innate or inspired intuition)—if it have any meaning at all—can only mean a reference to what experience teaches the general reason of mankind to expect as the probable result of any proposed course of action on the general happiness. But the difficulty is far greater to ascend to the general axioms of morality from the facts of history and social life in the way of induction, in the face of so much acknowledged confusion in the results of human action in the more complicated affairs of life, than to start from an *à priori* and divinely inspired principle of right, interfered with in its application by the disturbing agency of passion and ignorance, in rendering an account of so much evil intermixed with so much good. Nor does this consideration appear to have been altogether without its weight in his choice of a starting-point, if we may judge from a passage in the work last cited (Systematic Morality, p. 133. Ch. 29 *et seq.*). The just celebrity of these works, and of his philosophical treatises, with his other eminent claims to scientific distinction, procured him the honour of nomination by the French Academy as a correspondent in the department of "Sciences Morales et Politiques—Section de Philosophie."

In 1839 he retired from the tutorship of his college, devoting himself thenceforwards entirely to those pursuits which he felt to be more congenial to the natural bent of his genius and to his personal habits, than the practical routine of education. What, and how expansive, and at the same time how definite and sober were his views on the subject of the higher education in general, and of that which ought to be the more especial object of a University education, may be gathered from a series of essays and treatises published from 1835 to 1845 on this subject, one of which, a brief essay entitled 'Thoughts on the Study of Mathematics as a part of a liberal education' (1835), involved him in a controversy with a very formidable antagonist (if we are not mistaken, the late Sir Wm. Hamilton), who, in an elaborate article in the Edinburgh Review (No. 126), laboured to show that so far from being an essential and important means of cultivating "the noblest faculties in the highest degree," such studies effect this purpose "at best in the most inadequate and precarious manner," and that, in point of fact, they "have less claim to encouragement than any other object of education." Dr. Whewell, however, was quite as

strenuous an advocate for the importance of classical as of mathematical studies as part of a course of liberal education, as well as for admitting, if not insisting on, the study of natural history and other branches of Natural Science as a means of developing the intellectual faculties, and of jurisprudence, not only for its intimate connexion with systematized morality, but as one of the best exercises in, and exemplifications of, applied logic.

In May 1841 he published his 'Mechanics of Engineering,' a most useful and much-needed elementary treatise on the practical application of mechanical principles to questions of construction and machinery. In the summer of that year he married Cordelia, the second daughter of John Marshall, Esq., M.P., of Hallsteads and Patterdale Hall, Cumberland, and in October of the same year succeeded Dr. Wordsworth in the Mastership of Trinity College, which he retained during the remainder of his life. In this distinguished and important office (to use the words of one excellently qualified to judge), though "there were some who feared that the new Master would be imperious and overbearing, their fears were dissipated by the result. His government was, with scarcely an exception, the government of a constitutional monarch, not of a despot. Of his rights and privileges he was tenacious enough, but he preferred to delegate the active exercise of his power, and its consequent responsibility, to the several college officers, and was best pleased when all went smoothly without reference to him. He did not interpose *nisi dignus vindice nodus*. The Lodge was the scene of generous hospitality, and received a constant succession of distinguished guests." His wife, a most amiable and excellent lady, suffered for several years from a painful illness, during which his care and attention were unremitting though unavailing; and in December 1855 he was left a widower. From the deep grief and distaste for his usual philosophical pursuits, and from the melancholy associations of his college residence, he sought at length relief in a visit to Rome (resigning his Professorship of Casuistry), where, however, with characteristic eagerness for the continual accumulation of mental acquirement, he devoted much of his time to perfecting his knowledge of the Italian language, "taking lessons and writing exercises like the veriest schoolboy." Returning, and resuming his college duties, in 1858 he married Lady Affleck, widow of Sir Gilbert Affleck, a lady whose sweet disposition and engaging manners rendered her universally beloved, and contributed not a little to the increasing popularity with which he at length came to be regarded in the University,—the inherent dignity and loftiness of his character, and the splendour of his reputation, now universally recognized as adding lustre both to his college and to the University, overcoming somewhat of a contrary feeling which, in the earlier part of his career, had prevailed as the result of a certain uncompromising stiffness of demeanour and impatience of opposition.

In 1858 appeared his 'Novum Organum Renovatum,' and in 1860 his 'Chapters Critical and Historical on the Philosophy of Discovery,' being in part a reproduction of particular portions of his 'Philosophy of Inductive Science,' of several essays on Plato, Aristotle, &c., communicated to the Cambridge Philosophical Society, and of a series of 'Remarks on Induction with reference to Mr. Mill's Logic' (1849)—in part comprising several new and very striking chapters on the theological views suggested by physical discovery.

His devotion to the Platonic view of the ideal world seemed to grow with his growth and strengthen with his strength, and may be said to have culminated in his Platonic Dialogues, which appeared in 1860, 1861, and 1862, being in effect a translation of the most important portions of Plato's dialogues, accompanied with a kind of running comment, explanatory of such portions as might be judged irrelevant or tedious if translated at length—a work which he declares to have been "not lightly executed, but the labour of many years; each part gone over again and again."

In 1861 he was called upon by His Royal Highness the Prince Consort to deliver, for the express instruction of the young Prince of Wales (then a student of Cambridge), a short course of lectures on Political Economy. This, as we have seen, was a subject which had engrossed a large share of his attention at an earlier period, and which he never relinquished, being an ardent admirer of his distinguished contemporary and dear friend Professor Jones (whose posthumous works he edited), and whose volume on Rent he considered as the only work in which that subject is treated in its most general aspect, and on truly correct principles. Accordingly we find in these lectures, which he subsequently published, frequent reference to his views, and copious extracts from the work itself.

In 1865 he again became a widower. Stern and somewhat hard as he may have appeared to those who knew him but imperfectly, no man was ever more susceptible of the gentle and tender influences of female society, or had a deeper sentiment of domestic affection, and this last blow for a time completely overcame him. By very slow degrees, and cheered by the society of an attached relative of his former wife, he so far recovered as to be able to resume his philosophical pursuits, and to compose a short but highly interesting article on "Comte and Positivism," which appeared in MacMillan's Magazine. It was his last production. On the 24th February 1866, while riding a horse which had twice before thrown him (for though a bold, and even a reckless rider, he was by no means a first-rate horseman, riding negligently, and, in the present instance, probably greatly enfeebled, and perhaps affected by vertigo), he was observed by the ladies in a carriage, beside which he rode, to have lost the command of his horse, and to be partially unseated. Shortly after the horse appeared without his rider, and he

was taken up senseless, having received a concussion of the brain, unaccompanied however by any fracture. For a time hopes were entertained of his recovery, but they proved delusive. The fatal termination took place March 6, 1866; and on the 10th his remains were deposited, with every possible honour, and with an immense attendance on the part of the University, in the Chapel of Trinity College, at the feet of the statues of Newton and Bacon (the latter his own gift to the college). He left no family, and as he had throughout life identified himself with the University and the College in which he had won fame and acquired wealth, so, at his death, he devoted the bulk of the latter to increasing their efficiency. The particular light in which he regarded systematic morality had led him to a careful study of the principles of jurisprudence and of the law of nations, during the course of which he had been led to publish a translation of the great work of Grotius, ‘*De Jure Belli et Pacis*,’ and justly considering that international law as a branch of the higher education was far too much neglected in this country, he provided by his will for the liberal endowment of a professorship and studentships of that science in the University; while, for the future enlargement of his college, he left a large and valuable area of adjacent ground, purchased for the purpose during his lifetime, together with ample funds for building on the site.

To the worth and nobleness of his personal character it is scarcely possible to do justice within the brief compass of a notice like the present. Those who would appreciate it fitly will find it admirably delineated, and with a truth and fidelity which leave nothing to desire, in the biographical notice from which one passage has been already quoted above*. Of his works other than scientific, a brief mention will suffice. His ‘*Architectural Notes on the German Churches*,’ and ‘*Notes written during an Architectural Tour in Picardy and Normandy*,’ have been pronounced standard works on ecclesiastical architecture. The enumeration of the long list of churches visited, and noted by him according to a regular and systematic plan of annotation, in the course of a summer excursion, in the former of these works, will serve to give some idea of the surprising activity and energy with which he threw himself into everything he undertook. In 1847 he edited a collection of English hexameters and elegiacs by various authors, himself contributing a translation from the German of Goethe’s *Herman and Dorothea*. Of the admission of these metres into our English verse he was always a strenuous advocate, justly apprehending their many and powerful claims to such reception, and turning a deaf ear to the prejudice which would refuse them their merited place in our literature. He translated also Auerbach’s ‘*Professor’s Wife*.’

The essay on the ‘*Plurality of Worlds*’ (attributed to him, though

* William Whewell. In *Memoriam*. By G. W. Clark, M.A., Public Orator in the University of Cambridge. *MacMillan’s Magazine*, No. 78.

published anonymously), can hardly be regarded as expressing his deliberate opinion, and should rather be considered in the light of a *jeu d'esprit*, or, possibly, as has been suggested, as a lighter composition, on the principle of "*audi alteram partem*," undertaken to divert his thoughts in a time of deep distress. Though it may have had the effect I have heard attributed to it, of "preventing a doctrine from crystallizing into a dogma," the argument it advances will hardly be allowed decisive preponderance against the general impression which the great facts of astronomy tend so naturally to produce.—J. F. W. H.

NICHOLAS WOOD was born at Sourmires, a village near Newcastle-on-Tyne, April 24th, 1795. While at school, in the same neighbourhood, he attracted the notice of Sir Thomas Liddell, and through his influence was placed at Killingworth Colliery, to learn the practice of a coal-viewer. Here he made acquaintance with George Stephenson, who was beginning to develope that skill and ingenuity which afterwards made him famous. The two young men became intimate, and both worked energetically in carrying out the plans of the inventor of the future locomotive. Wood made the drawing of the first safety-lamp, and was fearless enough to accompany Stephenson in a trial of the lamp first constructed therefrom, at a "blower" in the mine. Taking the time and circumstances into account, this experiment must be recognized as a manifestation of a high degree of moral as well as physical courage on the part of the two operators. Some of Wood's earliest scientific papers, published in local journals about the year 1815, were on the use of the lamp in mines and on points in the controversy which its use had originated. In the fact that Stephenson afterwards placed his son Robert under Wood as a pupil, we have a further proof of the confidence existing between them.

In 1825, the year of the opening of the Stockton and Darlington railway, Mr. Wood published a 'Treatise on Railroads,' which, embodying what was then known of the principles and practice of railway construction, has passed through three editions, and is still regarded as a standard work, notwithstanding that in the first edition the author treats as "ridiculous expectations" the views of those who were sanguine enough to believe that locomotives could be made to run twenty miles an hour.

In 1827 Mr. Wood gave evidence before the Parliamentary Committee on the proposed railway from Liverpool to Manchester. His opinion was highly valued, especially on subjects connected with coal-mining, so that in parliamentary inquiries relating to such subjects he was usually summoned as a witness. With a growing reputation as geologist and mining-engineer, he communicated, in 1830 and 1831, to the Natural History Society of Northumberland, Durham, and Newcastle-on-Tyne, two papers, which were published in their 'Transactions' as valuable contributions to the then existing knowledge of the geology and palæontology of the district. The subject was extended and further elucidated in two papers read at the

Meetings of the British Association at Newcastle in 1838 and 1863. In these papers the limits of the several formations—the millstone grit, the mountain limestone, and true coalfields—are defined, the courses of “dykes” are laid down, their effect on the coal-measures is pointed out, and in the numerous sections a clear view is given of the structure of the country. In the paper on “The Wash,” a remarkable denudation through a portion of the coalfield of Durham, written jointly with Mr. Boyd (1863), the effect of a great stream in remote epochs, in producing the present geological configuration, is ably traced.

The demands on Mr. Wood’s time and practical skill multiplied with the increasing demand for coal for lighting and manufacturing purposes. In 1844 he proposed a registration of mining operations as important alike from the geological as from the commercial point of view. He was a member of the local Committee afterwards formed to draw up a report on the best method of preventing or diminishing accidents in coal-mines, out of which resulted the Mines’ Inspection Act of 1851. In the following year, with a view to give effect to practical suggestions, a scheme for a society was proposed which in August of that year took shape as the North of England Institute of Mining Engineers, with Mr. Wood as President. From that time to the end of his days he was annually elected to the same honourable post, and discharged the duties thereof with advantage, during a period in which, besides his inaugural address, he contributed fourteen papers on important professional subjects to the Society’s ‘Transactions.’ In his address, as well as on other occasions, he reiterated his appeal for the formation of a collection of plans and records as a means of promoting mining and geological science. These papers, with one on “Improvements in the Working of Coal-Mines,” communicated to the Society of Mechanical Engineers, and published in their ‘Proceedings,’ were the latest of his writings.

In 1844 Mr. Wood removed from Killingworth to Hetton Hall, co. Durham, where, while health permitted, he continued his active labours particularly in the attempt to establish a school or College “for the cultivation, improvement, and teaching of mining science, especially as applicable to coal-mines.” The attempt failed, but the discussion had a beneficial effect in attracting public attention, and in impressing the Government with its importance.

Mr. Wood was a member of the local societies in his neighbourhood, of the Geological Society, of the Institution of Civil Engineers, and in 1864 was elected a Fellow of the Royal Society, but did not live long to enjoy the honour. He had been for some years a widower, when failing health compelled him to give up the duties which he had so beneficially discharged, and to resort for medical advice to London, where he died December 19, 1865, leaving four sons and two daughters. He was characterized throughout life by a calmness of temper which nothing disturbed; and one who knew him well has recorded concerning him, that, “whether he be viewed

as an employer of labour, as a successful man of business, as a promoter of knowledge, as a friend to education among all classes, as a neighbour, a parent, or a friend, we may safely say that his place in society will not easily be filled."

JOHN, LORD WROTTESLEY, was born on the 5th of August 1798. His father, the first peer, was the representative of a family which was of distinction when it acquired the estate of Wroottesley, near Wolverhampton, at a date which may be best remembered by the fact that the fourth possessor, and the third who took his name from it, was made a Knight of the Garter at the institution of the order. The subject of our memoir graduated at Oxford with a first class in mathematics, and was called to the bar, at which he practised for several years as an equity lawyer. His tastes were scientific. He showed them when he joined the Society for the Diffusion of Useful Knowledge, in the Committee of which he worked during the whole existence of the body: in its earliest days he wrote a number of the Useful Knowledge Library, on navigation. In 1831 he became one of the Secretaries of the Astronomical Society, of which he was afterwards President (1841-43). He became President of the Royal Society in 1854, on the retirement of Lord Rosse, and held this post until 1858. He died Oct. 27, 1867, aged sixty-nine. No life was more devoid of striking incidents than his: the only exceptions to its even tenour were the loss of two worthy sons, one of whom fell in action at the Cape, the other at Bomarsund.

His characteristics, says a journal obituary, were plain manners, kind feelings, sound judgment, and useful intellect. His knowledge of law, his pursuit of science, and his conduct of life were equally practical and equally unobtrusive. His particular pursuit was astronomy, which he carried on in two small observatories, one at Blackheath, while he was engaged at the bar, the other at Wroottesley, after his accession to the title in 1841. In 1839 he received the gold medal of the Astronomical Society for a catalogue of stars. This work was performed by himself with the aid of Mr. Hartnup, now at the head of the Liverpool Observatory, whom he trained as his assistant. The object of it was to make systematic observations of the right ascensions of all the stars of the Astronomical Society's Catalogue, of the sixth and seventh magnitudes; the higher magnitudes having been undertaken, or rather having been supposed to have been undertaken, by other observatories. Comparison with various cases obtained from public observatories showed that Mr. Wroottesley's catalogue was, as it was styled by Mr. Baily in delivering the medal, of first-rate importance and entitled to implicit confidence.

Lord Wroottesley also communicated two astronomical papers to the Royal Society—one, "On the Results of Periodical Observations of the Positions and Distances of certain Double Stars," published in the *Philosophical Transactions* for 1851; the other, which was published in the

“Proceedings” for 1859, is entitled “On the Application of the Calculus of Probabilities to the results of Measures of the Position and Distance of Double Stars.”

During the four years of his presidency of the Royal Society, Lord Wrottesley was unremitting in his attendance at the meetings of Council, and his conduct of business was guided throughout by the clearness of insight and rectitude of judgment which belonged to his mental character. Among the various subjects which came under his consideration during this period, there was one in which he may be said to have taken a special interest; the question, namely, whether any measures could be adopted by the Government or by Parliament which would improve the position of science and its cultivators in this country. The subject was brought under the consideration of the Parliamentary Committee of the British Association, of which Lord Wrottesley was Chairman; and the Committee, after corresponding with eminent men of science and learning their views on the question, presented a Report to the Meeting of the Association at Glasgow in 1855. In the following summer a motion was made in the House of Commons, by Mr. James Heywood, for a Select Committee to inquire into this question, which was, after some discussion, withdrawn, in order, as it was understood, to allow the matter to be previously considered by scientific men. On this, Lord Wrottesley, without loss of time, brought the matter before the Council of the Royal Society, who referred it in the first instance to the Committee who assisted them in the distribution of the Government grant, and finally adopted a series of resolutions which were communicated to Lord Palmerston, then First Lord of the Treasury: but a change of Government and a dissolution of Parliament having soon afterwards taken place, the matter was not again brought before the Legislature. Both as Chairman of the Parliamentary Committee of the British Association and as President of the Royal Society, Lord Wrottesley conducted the correspondence relating to this question, and took the chief share in drawing up the Reports.

Lord Wrottesley was President of the British Association at its Meeting in Oxford in 1860, and in his Address delivered on that occasion, he earnestly recommended due encouragement of the Physical and Natural Sciences as branches of University study. On a later occasion, in a speech delivered in the House of Lords in 1865, on the Public Schools Bill, he strongly urged the expediency of introducing science as an important branch of school teaching.

ALEXANDER DALLAS BACHE, For. Memb. R.S., was a son of Richard Bache, one of the several children of the only daughter of Dr. Benjamin Franklin. His mother was Sophia Dallas, the daughter of Alexander J. Dallas, and sister of George M. Dallas, whose names are well known in the history of the United States, the former as Secretary of the Treasury, and the latter as Vice-President of the United States, and subsequently as

Minister at the Court of St. James's. He was born in Philadelphia, on the 19th of July, 1806. At an early age he became a pupil of a classical school of celebrity, and was distinguished by unusual aptitude in the acquisition of learning. Shortly before arriving at the age of fifteen, he was appointed a cadet of the Military Academy at West Point, and graduated in 1825 at the head of his class.

After graduating, he was selected to remain in the Academy as an Assistant Professor, and in this position, which gave him an opportunity of reviewing his studies and examining his reading, he continued one year, when at his own request he was assigned to engineering duty at Newport, R.I. Here he remained two years, engaged in constructing fortifications, and devoting his extra hours to the study of Physics and Chemistry; and supported his mother and her younger children out of his stinted pay as Lieutenant of Engineers. An unexpected change now took place in his circumstances, which enabled him to marry. He was appointed to the Professorship of Natural Philosophy and Chemistry in the University of Pennsylvania, at Philadelphia. Having had, prior to this, some experience as a teacher, he soon gained the entire confidence of the authorities of the University and the affections of his pupils. He became a member of the Franklin Institute, a Society then newly established for the promotion of the Mechanical Arts. This Society was well calculated to exhibit his talents and develop his character. It brought him into intimate association with the principal manufacturers, engineers, and artisans of the city. Facilities were thus afforded him for the prosecution of science which he could not have commanded in any other way. Workshops were thrown open to him, and skilful hands offered ready assistance in realizing the conceptions of his suggestive mind. His descent from the illustrious Statesman and Philosopher, whose name the Institution bears, contributed in some degree no doubt to the influence which he acquired; but it was in the main to his own industry, ability, and courtesy that he owed the favour and distinction which, in assigning to him the principal directorship of scientific investigations, afforded him the means of so greatly contributing to the usefulness of the Society, and of advancing his own reputation. An account of the labours in which he was engaged in his connexion with the Franklin Institute will be found in the volumes of its Journal from 1826 to 1835 inclusive. The results of his investigations relating to the bursting of steam-boilers, after a lapse of more than thirty years, have not yet been superseded by any others of more practical value. These experiments were attended with no small amount of danger, and required in their execution no small amount of personal courage.

He erected an Observatory in the yard of his own house, in which, with the aid of his wife and his friend and former pupil, John Fraser, he determined with accuracy, for the first time in the United States, the periods of the daily variations of the magnetic needle, and in another series of observations the connexion of the fitful variations of the direction of the

magnetic force with the appearance of the Aurora Borealis. He also, in connexion with Mr. Espy, made a minute survey of the relative change of position of the trees and other objects in the track of a tornado which passed over New Brunswick. In connexion with Professor Courtenay he also made a series of determinations of the magnetic dip at various places in the United States. Indeed, terrestrial magnetism was with him a favourite subject, to which he continued to make valuable contributions at intervals during his whole life. He was also much interested in the phenomena of heat, and was the first to show, contrary to generally received opinion, that the radiation and consequent absorption of dark heat is not affected by colour.

In 1836, when Professor Bache had just attained the thirtieth year of his age, the Trustees of the Girard College, an institution munificently endowed by a benevolent citizen of Philadelphia, preparatory to organizing the College, resolved to select Professor Bache as the most proper man for the office of President, and to send him abroad to study the systems of education and methods of instruction and discipline adopted in Europe. It was with difficulty that he could bring himself to regard with favour a proposition which threatened to separate him from the pursuit of science. The consideration of a more extended field of usefulness at length prevailed, and he accepted the proffered position, though not without some lingering regret. No American ever visited Europe under more favourable circumstances for becoming intimately acquainted with its scientific and literary institutions. His published researches had made him favourably known to the cultivators of science, and gave him ready access to intelligent and influential society. He remained in Europe two years, and on his return embodied the results of his researches on Education in his Report to the Trustees of Girard College. This Report is an almost exhaustive exposition of the systems of education and methods of instruction in use at the time in England, France, Prussia, Austria, Switzerland, and Italy. The accounts which are given of the different schools of Europe are founded on personal inspection, the results being noted down at the time with his habitual regard for accuracy.

After completing his report he was prepared to commence the organization of the College, but the Trustees, partly on account of the unfinished condition of the building, and partly from a want of the final adjustment of the funds, were not disposed to put the Institution into operation. In the meantime, Professor Bache, desirous of rendering the information he had acquired of immediate practical use offered his services gratuitously to the municipal authorities of Philadelphia to organize on an improved basis a system of public education for that city. This offer was readily accepted; and he commenced the work with his usual energy, and with the cordial support of the Directors and Teachers of the common schools. The result of his labours was the establishment of the best system of combined free education which had at that time been adopted in the United States.

In 1842, having completed the organization of the schools, and finding that the Trustees of the College were still unprepared to open the Institution, he resigned all connexion with it, and yielded to the solicitations of the Trustees of the University to return to his former chair of Natural Philosophy and Chemistry. During his travels in Europe he provided himself with portable instruments, and made a series of observations on the dip and intensity of terrestrial magnetism at prominent points on the Continent and in Great Britain, with the view of ascertaining the relative intensity of the magnetic force in Europe and America. The observations also served in most instances to settle with greater precision the magnetic condition of the points at which they were made. In the midst of the labour of organizing the schools of Philadelphia he cooperated actively with the British Association in determining the fluctuations of the magnetic and meteorological elements of the globe by contemporaneous observations at places widely separated from each other. He established an Observatory, which was furnished with a complete series of the best instruments by the Girard College, and was supported by the American Philosophical Society, and a number of liberal and intelligent individuals. The observations, which were continued at short intervals day and night for five years, form a rich mine from which, until within the last few years of his life, he drew a highly interesting series of results without exhausting the material. In addition to these observations, he made during his summer vacations a magnetic survey of Pennsylvania.

In November 1843, on the occasion of the death of Mr. Hassler, he was called to take charge of the United States Coast Survey. Though he undertook the task with many misgivings, it may be truly said that no other living man was so well qualified to secure the results which the nation and its commercial interests demanded. His education at West Point, his skill in original investigations, his thorough familiarity with applied science, his knowledge of the world and his gentlemanly deportment were all essential elements in the successful prosecution of the Survey. Besides these qualifications he possessed rare executive ability, and governed and guided the diverse elements of the vast undertaking with consummate tact and skill. Quick to perceive and acknowledge merit in others, he rapidly gathered around him a corps of men eminently well qualified for the execution of the tasks to which he severally assigned them. Up to the time of the appointment of Professor Bache little more than a beginning of the Survey had been made. It extended only as far from New York harbour as Point Judith on the east coast, and southward to Cape Henlopen. The new Superintendent saw the necessity of greatly enlarging the plan so as to embrace a much broader field than it had previously included. He divided the whole coast-line into sections, and instituted under separate parties the essential operations of the Survey simultaneously in each. He commenced the exploration of the Gulf-stream, and at the same time projected a series

of observations on the tides, also of the magnetism of the earth, and the direction of the wind at different seasons of the year. He also instituted a succession of researches in regard to the bottom of the ocean within soundings, and the forms of animal life which are found there, thus offering new and unexpected indications to the navigator. He pressed the electric telegraph into the service for the determination of the longitude, photography for the ready reproduction of charts, and the art of electrotyping for multiplying copperplate engraving. Professor Bache, with his enlightened appreciation of the value of abstract science, kept constantly in view the various problems relative to the physics of the globe which were incidentally connected with the survey of the coast, and ever cherished the hope of being permitted to finish his labours by their solution. Among these was a new determination of the magnitude and form of the earth, the variations in the intensity of gravity at various points on the continent of North America, the discussion of the general theory of the tides, the magnetic condition of the continent, and the improvement of the general map of the United States by determining in relation to the coast-line, the geographical positions of the most important points in the interior.

He was Superintendent of Weights and Measures, and rendered important services as a Member of a Commission to examine the condition of the Light House System. In 1846 he was named one of the Regents of the Smithsonian Institution, and by successive reelection was continued in this office until his death. At the request of the Governor of Pennsylvania, although overwhelmed with other public labours, he planned a line of defences for Philadelphia, and to a considerable extent personally superintended their construction. This work proved too much for his strength, and brought on the malady which terminated his life.

After some premonitory symptoms, which, however, did not diminish his exertions, he was suddenly deprived in a considerable degree of the power of locomotion, and of the expression of his ideas. For several months he was very anxious about the business of the Coast Survey, and it was with difficulty that he could be restrained from resuming the full duties of his office. It was hoped that a voyage to Europe would be of service to him; the journey, however, was productive of no permanent advantage; and after lingering for more than two years, he departed this life on the 17th of February 1867.

But few Americans have been more highly honoured at home or more appreciated abroad. He was President of the American Philosophical Society, of the American Association for the Advancement of Science, and of the National Academy of Sciences lately established by Congress. He was a Foreign Member of the Royal Society of Edinburgh, the Royal Irish Academy, the Royal Astronomical Society, a Corresponding Member of the Imperial Institute of France, of the Imperial Academy of St. Petersburg, of the Royal Academy of Turin, of the Institute of

Bologna, of the Royal and Imperial Geographical Society of Vienna, and the Mathematical Society of Hamburg. He was elected a Foreign Member of the Royal Society in 1860.

The preceding notice has been extracted from a manuscript memoir of Professor Bache kindly supplied by Dr. Joseph Henry.

GEORG FRIEDRICH BERNHARD RIEMANN was born on the 17th of September 1826 at the village of Breselenz, near Dannenberg, in Hanover. He was the second of six children born to the Pastor of Breselenz. Under his father's sole tuition till eight years of age, he exhibited great powers of arithmetical calculation. An able tutor, who from this time assisted in teaching him, was forced to make unusual exertions in order to follow the short and original solutions of the problems proposed to his pupil.

In the spring of 1840 Riemann was sent to the Lyceum in Hanoer, where he remained two years. He was then placed in the Gymnasium of Lüneburg under Director Schmalfuss. The latter soon discovered Riemann's mathematical talent, and not only gave him problems made expressly for him during school hours, but lent him works on the higher mathematical subjects, which he brought back after having thoroughly mastered them in the course of a few days. A week sufficed to make Legendre's theory of numbers his own for life.

He entered the University of Göttingen at Easter 1846, by his father's wish, as a student of theology. Here the lectures of Gauss stirred up in him such a passion for exact science that he sought and obtained permission from his father to devote himself entirely to the studies of his choice. For two years, commencing with Easter 1847, he studied under Jacobi at Berlin. He then returned to Göttingen, and graduated, his dissertation on the foundations of a general theory of functions of a variable complex magnitude obtaining the warm approval of Gauss.

In 1854 he qualified for the post of a teacher by a lecture on the hypotheses on which geometry is founded, and by writing a memoir on the representation of a function by a trigonometric series. In September of the same year he wrote on the distribution of electricity in non-conductors. In 1855 he contributed to Poggendorff's 'Annalen' a paper on the theory of Nobili's coloured rings, and one on the mathematical theory of the galvanic current. During the two following years he suffered much from failing health.

In 1857 he became Professor Extraordinarius, and wrote four papers which appeared in vol. liv. of Crelle's Journal. In 1859 he was elected a Corresponding Member of the Academy of Sciences of Berlin, and contributed to the 'Abhandlungen' of the Academy a memoir on the number of primes below a given number, and was nominated Professor Ordinarius. In 1860 he was elected a member of the Academy of Sciences of Göttingen, and in the course of this and the following year wrote a memoir on the propagation of plane waves of finite amplitude in air, and one

on the motion of a fluid homogeneous ellipsoid. These two memoirs were printed in the eighth and ninth volumes of the 'Abhandlungen' of the Society.

Riemann married in 1862. In July of the same year he suffered from an attack of pleurisy. Through the good offices of Professors Weber and v. Waltershausen he obtained leave of absence and pecuniary assistance from a fund available for such purposes, to enable him to travel in Italy. He quitted Göttingen in November and passed the winter in Messina. His health in some degree restored, he left Messina in March 1863, on his homeward journey, stopping in Palermo, Naples, Rome, Pisa, Florence, and Milan, and making the acquaintance of the most distinguished men of science of Italy. He arrived in Göttingen in July, suffering from a relapse caused by exposure to cold in crossing the Splügen. In the following August he entered upon his second journey to Italy. The Professorship at Pisa, vacant by the death of Mosotti, was offered to him at the suggestion of Professor Betti, but declined by the advice of Riemann's friends on account of the state of his health. He passed two successive winters in Pisa. In the autumn of 1865 he returned to Göttingen, and began to write a paper on the mechanism of the ear, which was published after his death by Professors Henle and Schering. He entrusted the completion of a paper on the surface of least area, having a given boundary, to Dr. Hattendorff. This paper is printed in vol. xiii. of the 'Abhandlungen' of the Society of Göttingen. Desirous of passing some months on the shores of the Lago Maggiore in order to collect strength sufficient to enable him to complete his unfinished works, he left Göttingen on the 16th of June 1866, and after some delay, caused by the events of the war, reached Lago Maggiore on the 23rd of the same month.

Perfectly conscious of his approaching end, and fully prepared for it, he repeatedly urged his physician to tell him how long he had to live, in order that he might thereby be guided in the selection of a labour that it might be possible for him to complete. He died in entire possession of his faculties on the 20th of July 1866, at Selasca, near Intra, on the Lago Maggiore, having only the day before worked on the mechanism of the organs of hearing, whilst he warned his attendants that his death was at hand.

He is gratefully remembered by his pupils for his liberality in imparting to them the results of known, new and important unpublished researches, and for the unwearied zeal with which he strove to impress upon them the whole truth of his lessons.

The materials for the preceding sketch of Professor Riemann's life were obtained from a 'Gedächtniss-Rede,' addressed to the Royal Society of Göttingen by Professor Schering, and some manuscript notes supplied by Professor Clebsch.

SIR EDMUND WALKER HEAD was born at Wiarton Place, Kent, February 16, 1805. His ancestor, created a baronet in 1676, resided at the hermitage near Rochester, in Kent; and his seat is said to have afforded shelter to James the Second during the memorable week of December 1688, the last which he spent in England. The grandfather of the subject of our memoir, Sir Edmund, emigrated to America, and settled at Charleston. In the War of Independence he took the Royalist side, lost the greater part of his fortune, and returned to England, bringing with him his son, afterwards Sir John. This portion of the family history was much noted in Canada and in New Brunswick when the descendant and namesake of this Sir Edmund went to administer the government of those provinces, in both of which there are many families descended from the "loyalists" of the last century.

Sir John became a clergyman, and had by his wife, Miss Walker, two children, Sir Edmund and Annette, wife of the Baron de Milanges. He died in 1838.

Edmund was sent to Winchester in 1815, where he became, through his rapid proficiency, a very favourite pupil of Dr. Gabell, the then head master. "It is hard," writes the Doctor to Sir John, in 1822, "to part with so delightful a boy; but there is virtue in parting with him: pray do not detain him beyond the proper time." He entered Oriel College, Oxford, as a gentleman commoner in January 1824, was first class in classics 1827, and elected to a fellowship of Merton.

Thus introduced into the academical world of his day, Edmund Head became familiar, and continued so through his life, with many of the leading men of that remarkable time for Oxford, and especially for Oriel: the two Newmans, the three Wilberforces, Froude, Manning, Wrangham, Edward Villiers, Denison, the Bishop of Salisbury were all more or less nearly his cotemporaries, and members of his Oxford circle. But of the friendships which he formed at that place, the most lasting, and in its consequences to himself the most important, was with George Cornewall Lewis, then student of Christ Church. No two men could be more singularly fitted to love and esteem each other, and, in a certain sense, to supply each other's deficiencies. Both were strongly addicted to the study of the past; but Lewis more in relation to antiquities and politics, Head especially in the province of history and art. Both were classical scholars of mark—Lewis, no doubt, with far more of industry and research, Head with at least equal elegance. Both were early engaged in the same line of political and social speculations; and in both liberal tendencies were accompanied by the same singular candour and modesty of judgment. Some of the epitaph, so to speak, composed by Sir Edmund for his predeceased friend, in his preface to 'Lewis's collected Essays on the Administration of Great Britain' (1864), seems, to those who knew and valued them both, to

illustrate his own character almost as much as that of the subject of his panegyric. "He rarely formed an opinion without looking at all sides of the question before him, or without having recourse to all accessible sources of information, which few men knew so well where to seek as he himself did. He was deluded by no prejudices, and jumped to no conclusions without testing them by the application of sound common sense. When he had thus formed an opinion, he adhered to it steadily, but not obstinately. He was ever open to argument, and he never refused to listen to it because it conflicted with his own view of the case. He had none of those crotchets or fancies lurking in his mind which so often taint the reasoning."

The classical accomplishments of Sir Edmund's early years he retained through life, though multiplicity of business on the one hand, and the prevalence in his mind of other tastes, especially for art, on the other, prevented him from "keeping up" his classics as sedulously as some other politicians of his generation have done. But the readiness with which he could apply his early knowledge was often displayed—never more neatly than in the prefatory quotation which he furnished to Professor Tyndall for his paper on Calorescence (*Phil. Trans.*, Read Nov. 23, 1865).

Forsitan et roseâ sol altè lampade lucens
Possideat multum cæcis fervoribus ignem,
Circùm se, nullo qui sit fulgore notatus,
Æstiferum ut tantùm radiorum exaugeat ictum.

Lucret. v. 160.

"I am indebted to my excellent friend Sir Edmund Head," says the eminent Professor, "for this extract, which reads like divination."

Not long after his election to Merton in the year 1830–31, Sir Edmund travelled over most part of Spain in company with David Roberts the artist, then engaged in making drawings for his work on that country. Three of the plates in that work, namely the view of Ronda, of the viaduct at Segovia, and the bridge at Toledo, are from his sketches. It was on this occasion that he made acquaintance with Richard Ford (then residing at Seville), the accomplished and genial author of the 'Handbook for Spain,' which ripened into a durable intimacy.

Sir Edmund brought back from his tour in Spain, and also in Italy, an increased devotion to the pursuits of what was formerly termed a "virtuoso," fondness for art, and familiarity with its history and specialties, especially the art of painting. The second part of Kugler's 'Handbook of Painting,' published in English by Murray, that which relates to the German, French, and Dutch schools, was edited by him. The third part (Spanish and French schools, published as a separate work in 1848) is his composition.

It was his intention, on leaving Oxford, to follow the civil law as a pro-

fession; but his scheme of life was altered through his intimacy with Lewis, whose father, Sir Frankland, was at the head of the Poor Law Board. Through the son's influence, Head became Assistant Poor Law Commissioner in 1836. He organized the unions in Herefordshire, the district assigned to him. It was on that occasion that he made the acquaintance of the lady who became his wife, Anna Maria, third daughter of the Rev. Philip Yorke. They were married in 1838. In the same year the baronetcy devolved on him by the death of his father. The issue of the marriage were three children—a son, accidentally drowned in Canada, and two daughters, surviving.

From Herefordshire he was transferred to the London district, and in 1841, on the resignation of Sir John Lefevre, became one of the chief Commissioners, with his friend Lewis and Sir George Nicholl. This memoir does not afford an occasion for recurring to the accusations and Parliamentary discussions, with which, indeed, Sir Edmund had personally little to do, which produced the disruption of that Board in 1847. It was reconstituted by Act of Parliament in that year under a new organization; but Lewis and Head were not included in the latter.

In 1847 Sir Edmund was appointed Lieutenant-Governor of New Brunswick by Lord Grey, then Secretary for the Colonies. The period of his appointment coincided with that of a great constitutional change in the government of the dependencies of Great Britain, the introduction of what is called "responsible government." Canada was already undergoing the transition to the new state of things under the able management of the Earl of Elgin. New Brunswick and Nova Scotia were the next subjects of experiment. Although the field of action thus afforded to Sir Edmund was but a small one, it was one which taxed the abilities and the temper of the administrator to the full extent. He occupied a post exposed to attack, on the one side, from colonial politicians who were bent on pushing their newly gained independence to excess, and British members of Parliament and politicians on the other, who could not for a long time be brought to comprehend the nature of the gift which they had bestowed, nor why a colony, having achieved the right to conduct its own affairs, was to be allowed to conduct them in a way which they disliked. And many points of serious difference were long left unsettled—the management of the public laws, the disposal of the reserved revenue, then called the "civil list," the embarrassing question of the initiation of money votes by the local government instead of at the caprice of individual members. During seven years of government in New Brunswick Sir Edmund Head contrived so far to smooth away these causes of differences, that few portions of the British empire have been better or more quietly governed than that which he conducted through this first stage of self-government. Cautious almost to excess, entirely free from that self-importance which induces colonial governors at times to forget that the maxim of "reigning and not govern-

ing" is to be carefully followed except in peculiar emergencies, he united with these qualities a very conscientious loyalty to those with whom he was placed in contact. To let every project which he initiated be thoroughly known beforehand to his local advisers on the one hand, and to his superiors in office at home on the other, was with him a fundamental rule of conduct. And the result was, that, though often opposed on the one hand and sometimes overruled on the other, he was always and thoroughly trusted.

The monotony of colonial life in a remote and thinly peopled province was diversified, for Sir Edmund Head, by a strong love of nature and attachment to outdoor pursuits. He had a taste for geology, and induced the legislature of New Brunswick to employ Professor Johnston to survey the province, and publish a report on its agricultural capabilities based on its geological formation—a work of considerable local value. In later years he took great interest in the geological survey of Canada, accompanied Sir William Logan in his field operations, and took part in many a discussion on the mysteries of the "Laurentian strata." And besides his addiction to landscape-art and the picturesque, he was, moreover, a very eager and accomplished sportsman. Some of his happiest intervals of busy life were spent in the wild backwoods of New Brunswick, with Lady Head for his companion, geologizing, sketching, fishing, and shooting, until the close of the late Indian summer called them back to official employment.

In September 1854 Sir Edmund Head was promoted to the office of Governor of Canada and Governor-General of British North America, on the resignation of Lord Elgin. In this instance Lord Elgin had laid the foundation of that system of government which was afterwards administered by Sir Edmund. But the period of his administration was signalized by serious difficulties and important changes.

Not long after his assumption of the Government of Canada the Russian war broke out (1854-56). It will be in the recollection of those who watched the events of that anxious period into what embarrassment this country was for a time thrown by the difficulty of obtaining soldiers for our immediate demand, and how greatly that embarrassment was increased by the apprehension on that subject, amounting to a panic, which took possession of the public mind. Well-meaning but over-zealous agents suggested, and attempted, the levy of recruits among British subjects, not only in our American colonies, but in the United States. Rightly or wrongly, the jealous spirit of our kindred of the Republic was aroused by the proposal, and by the very slight attempts which were made to carry it into execution. Sir Edmund Head, accustomed as he was to dealing with the Americans, saw at once its extreme danger and checked it immediately, at all hazards to his own popularity, along the precarious line of boundary between his colony and the States.

"I am not in the habit of boasting," he says in a private letter of this date; "nor do I pretend to have foreseen all the consequences; but I sincerely believe that if I had given in to some of the recruiting schemes, and had thus generated a hostile feeling at Buffalo and along the frontier, war would have been upon us before this time." The danger was averted; and Sir Edmund employed himself in promoting the more worthy plan of raising troops openly in Canada itself. This was accomplished, or at least initiated, by the levy of the "hundredth," or "Canadian" regiment. But the termination of hostilities rendered its services unnecessary. It was a strong proof, however, of the popularity of the measure in the colony, that Sir Edward received between two and three hundred applications for officers' commissions.

The next question which engaged Sir Edmund Head's serious attention was one of magnitude in itself, but rendered more difficult by the amount of local interests and rivalries which were engaged in it. Upper and Lower Canada had been united into a single province, some years before, under the administration of the colonies by Lord John Russell. But no decision was arrived at respecting the permanent seat of the future government. Since the union, therefore, the executive had been located, in alternate years, at Quebec and at Toronto—a change attended with much inconvenience to the public service. But to fix on a single capital was a decision which the local ministries shrink from taking, naturally fearful, as they were, of encountering the hostility of the rejected candidates. They therefore acquiesced in the course advised by Sir Edmund Head, of referring the question to the decision of the Queen, and praying her Majesty to select the site of their eventual metropolis. But the corporations of all the towns, which conceived themselves to have a claim to this honour and advantage, were to be first admitted to urge their respective claims. Accordingly, in the course of 1857, Quebec, Toronto, Montreal, Kingston, Ottawa, and Hamilton gave in their several memorials, showing their respective advantages in point of population, commerce, position, and capabilities of defence; and the case in behalf of each was urged with considerable ability. Sir Edmund Head's opinion was in favour of Ottawa; and that place was ultimately selected by the Queen in the Ministry of Lord Palmerston, but not without much careful investigation. The difficulties of the question, however, did not cease here. The youthful democracy of Canada were not easy to hold fast; and a considerable disposition was manifested to repudiate the decision which the Crown had taken on the invitation of the colonial authorities themselves. This opposition was surmounted, however, through the patience and tact of the Governor, as well as the general good sense of the community, and the conviction that (independently of the binding engagement into which they had entered towards the Crown) the problem was really soluble in no other way. Ottawa, situated on the frontier between the two ancient

provinces, became the capital of the colony, and is now that of the confederated "dominion."

In the same year, and in the conduct of those negotiations, Sir Edmund Head visited England, and was appointed of the Privy Council.

In 1860 occurred the "progress" of His Royal Highness the Prince of Wales through British North America. The Governor-General met the royal party at Gaspé, at the mouth of the St. Lawrence, and accompanied them in their lengthened tour through his province. Shortly after this he paid a visit to England, on which occasion he was made a Knight Commander of the Bath.

The last business of public importance in which Sir Edmund was engaged in Canada related to the confederation of the British North-American provinces. The movement towards the attainment of this object originated in Canada. By the terms of the union between the two divisions of that province, Canada East and Canada West had an equal voice in the proceedings of the legislature. But the latter division was rapidly outgrowing the former in population and wealth. The result was a collision of interests which tended to a deadlock in the Government—the reforming party in the West advancing the principle of representation according to numbers, the East clinging to that equality which the existing constitution secured to it. To obtain the union of the so-called Lower Provinces (Nova Scotia, New Brunswick, Newfoundland, Prince Edward's Island) with Canada, and thus to recast the entire political arrangement, was an obvious expedient for getting rid of the difficulty. Other motives concurred, but this was the principal; and in 1858 delegates from Canada waited on Sir Edward Lytton, then Colonial Minister, in order to urge it. The Governor-General, though sincerely anxious to promote the scheme, thought it of the utmost importance that the initiative should be taken by the communities themselves and not by the executive, and therefore confined himself to the exercise of his good offices in removing all difficulties in the way of the negotiation. Personally, he was of opinion that the best course would be to effect a union between the Lower Provinces first, and then to connect the newly-consolidated dominion with Canada. But circumstances rendered it impossible to proceed in that direction. The whole project, however, was adjourned for some time; nor was it practically revived until after the departure of Sir Edmund from Canada, which took place in 1861. It was finally carried into execution under the government of his successor, Lord Monk.

From the position which he had held in the University of Oxford and his taste for literary pursuits, it might have been expected that Sir Edmund should pay attention to the promotion of education and the extension of science in the provinces which he was called on to govern; and the sequel shows that he successfully exerted his influence to further these objects, both in New Brunswick and Canada.

In New Brunswick he took a lively interest in the extension and improvement of the Provincial University as a centre of liberal education ; and in order to overcome local difficulties he appointed a commission of inquiry. Sir Edmund attended the meetings of the Commissioners, and took a part in their discussions ; and although he was removed to Canada before the recommendations of the Commission were fully acted on, enough was done to ensure the permanence of the University and enhance its utility to the province.

On entering on his administration of Canada, one of the first acts of Sir Edmund (1854-55) was to promote the efforts of a number of patriotic gentlemen then engaged in the attempt to reorganize the M'Gill University, the only endowed institution in Lower Canada for the higher education of that part of the population which is of British origin. The Governor not only gave substantial aid to their enterprise, which has been highly successful and beneficial in its results, but through his influence secured the appointment of the present Principal, Dr. J. W. Dawson, a Fellow of this Society, under whom a flourishing school of natural science has been established in connexion with the University.

It was also largely due to Sir Edmund's influence that the provincial normal schools of Lower Canada were successfully established ; and it was during his administration and under his patronage that the Natural-History Society of Montreal was enabled to erect a new building and greatly to enlarge its collections and other means of usefulness.

In Upper Canada the University of Toronto especially has reason to remember the exertions of the Governor in preventing the division of its endowments, and in furthering the erection of its new and magnificent buildings.

The Geological Survey of Canada under Sir William Logan was regarded by Sir Edmund as an object of special interest and importance. In the first year of his administration he authorized the augmentation of the fund annually voted for its support, raising the amount from eight thousand up to twenty thousand dollars ; he took an early opportunity, without solicitation, of considerably increasing the salaries of the staff ; and when the welfare and even the continuance of the survey were endangered by political changes, he was always ready to befriend it.

These efforts of Sir Edmund Head made him distinguished as a Governor who understood the subjects and sympathized with the cultivators of science and literature, and occasioned the termination of his government to be viewed by these with sincere regret.

Seven years of official labour in New Brunswick, and seven in Canada, were now to be followed by seven years of comparative rest, which completed his career. But his period of retirement was employed in a variety of public labours. He acted for several years as an unpaid member of the Civil Service Commission for organizing competitive examinations for ap-

pointments in the public service, of the Commission appointed to consider the site of the National Gallery, and (in 1867) of the Trades' Unions Commission. And those who acted with him in these several capacities can bear testimony to the influence which he exercised through his singularly calm and temperate judgment and the unfailing considerateness with which he weighed the opinions of his colleagues. He was for the last five years of his life Chairman of the Hudson's Bay Company. In April 1863 he was elected a Fellow of the Royal Society. Besides his other literary works, of which mention has been made, he was the author of the little philological essay entitled "Shall and Will, two chapters on future auxiliary verbs" (1856 and 1858)—of a translation of 'Viga Glum's Saga' from the Icelandic (1866) (a language of which the study occupied him a good deal towards the end of his life)—of articles on art-subjects in the *Edinburgh Review*, on Eastlake (1847), Cavalcasella (1865), and Holbein (1866), on the law of settlement, on the American Civil War (1862)—and in the *Quarterly* on Isaac Taylor's 'Words and Phases,' and the 'Life of Sir John Eliot.' He also occasionally amused himself with poetical composition; his essays in that department, chiefly translations, appeared from time to time in *Fraser's Magazine*. He was engaged at the time of his death on editing a translation of Van Praet's volume of historical miscellanies, which has since been completed by Sir Alexander Gordon. If the subjects to which his attention was thus devoted appear to indicate rather a discursive mind than serious addiction to any individual study, it must be remembered that his business in life was the public service, and his pursuits in literature and art mere accessories, to supply an active intellect with employment in the intervals of its appropriate labour.

Sir Edmund Head died suddenly, on the 28th of January 1868, probably of disease of the heart, of which the existence was unknown to himself and his friends. With him the old Baronetcy enjoyed by his family became extinct.

JOHN DAVY was born at Penzance on the 24th of May, 1790 ; and he died in his 78th year, at Ambleside, on the 24th of January last. He was the youngest of five children, of whom Sir Humphry Davy, born twelve years before him, was the eldest. He survived his brother thirty-nine years ; and one of the most marked features in his character for the whole of this period, and, indeed, of his life, was the well-deserved gratitude and veneration with which he regarded that famous philosopher. His first introduction to scientific life was made at the age of eighteen, in the Laboratory of the Royal Institution, where his brother was then (1808) in the zenith of his fame, lecturing and prosecuting chemical research. Dr. Davy always considered the period of from two to three years during which he acted as an assistant to Sir Humphry as one of the happiest and best employed of his life. On relinquishing this post he studied medicine in Edinburgh, where he graduated in the year 1814, the same year in which he was made a Fellow of this Society. From the year 1815, up to the end of his life, he held various appointments in various parts of the world in the Army Medical Department. He passed a life of great activity, which was but little less varied than this short sketch will show the incidents of his history to have been. He has left behind him numerous papers on purely scientific subjects—chemical and biological ; he has written the history of his brother's life, and has also edited his works ; his medical experience has been embodied in a volume treating of Army Diseases ; and he has written accounts, partly scientific, partly of general interest, of the various countries—Ceylon, the Ionian Islands, and the West Indies—in which he was at different periods of his life stationed in the course of his professional duties. The fact that the Royal Society is now in course of publishing a Catalogue of Scientific Papers, renders it superfluous to specify Dr. Davy's very numerous memoirs individually ; and it will be the aim of this notice merely to give the main features of his life in outline, and to mark only the chief points upon which his multifarious labours threw light.

The first remark which a glance at a list of his contributions to science suggests, relates to the length of the period over which his activity in the way of research extended itself. His first paper was published in 'Nicholson's Journal' for 1811, and contained the result of certain investigations undertaken in vindication of the doctrines taught by his brother as to the simple nature of chlorine, or oxymuriatic acid, as it was then named, and as to the incorrectness of the then current views of the composition of hydrochloric, then known as "muriatic" acid. His last paper, one "On the Temperature of the Common Fowl," was read subsequently to his death before the Royal Society of Edinburgh this very year 1868.

During a considerable part of these fifty-seven years Dr. Davy was on actual service as a medical officer of the army. His services began in the campaign of 1815, when he was attached to a General Hospital in Brussels ;

he was shortly afterwards sent out to Ceylon, where he continued during the suppression of a rebellion and up to the year 1820. After this he was for several years on Mediterranean stations, in the Ionian Islands first, and afterwards at Malta; and he was sent by Lord Palmerston in the year 1839 on a mission to Constantinople, which lasted nine months, and aiming, as it did, at effecting a reform in the administration of the Turkish hospital system, ended in failure and disappointment. His last public duty was performed as an Inspector-General of Army Hospitals on the West-Indian Station during the three years 1845-1848. In the intervals of foreign employment Dr. Davy was usually on duty at home. An 'Account of the Interior of Ceylon,' a quarto volume published in 1821, 'Notes on the Ionian Islands and Malta, with some account of Constantinople,' two octavo volumes published in 1842, and a volume entitled "The West Indies before and since Emancipation," and bearing date 1854, contain the results of his observations and investigations into the non-medical history of these stations. In a work 'On the Diseases of the Army, with contributions to Pathology,' published in 1862, Dr. Davy has embodied the results of the medical experience which he gained in the discharge of his professional duties at home and abroad. Not the least valuable portions of this volume are those which relate to the ætiology of the yellow and other malarious fevers of the tropical and subtropical countries he was made familiar with. Ten years previously to the publication of this work Dr. Davy had acted as editor to Dr. Blair's volume on 'The Yellow Fever Epidemic of British Guiana.' It is well here to put on record that, whilst discharging the duties of an Inspector-General at Barbadoes, he found time to deliver and publish a course of 'Lectures on the Study of Chemistry,' with especial reference to the agricultural requirements of the island. Dr. Davy had many years previously acted as editor of Sir Humphry's well-known and much read treatise on 'Agricultural Chemistry.'

Two volumes of 'Researches, Anatomical and Physiological,' were published by Dr. Davy in the year 1839; and they were followed by a third on the same subjects in the year 1863. The papers collected in these three volumes are of a very varied character; those on the Torpedo; on the Structure of the Heart of Amphibia; on the Generative Organs of Cartilaginous Fishes; on the Blood-corpuscles of the *Ornithorhynchus*; on the Temperature of Man in the Tropics; on the ova of the *Salmonidæ*, with reference to the Distribution of Species; and especially those on the Blood and the cause of its Coagulation, are the most particularly noteworthy, and the most particularly connected with the author's name.

The debt of gratitude which Dr. Davy owed to Sir Humphry for the assistance and sympathy which he received from him in early life, he discharged, so far as such obligations can be discharged, by the publication in 1836 of 'Memoirs of the Life of Sir Humphry Davy, Bart.,' in two volumes; secondly, by his edition of the works of Sir Humphry in twelve volumes, the first of which is a Biography condensed from the two

volumes just mentioned, the author "carefully abstaining from all that was controversial and vindictory, trusting that what was before a duty was then superfluous;" and, thirdly, by the volume of 'Fragmentary Remains, Literary and Scientific,' which contained a sketch of his brother's life and was published in 1858. The sixth volume of this edition of Sir Humphry Davy's works, and the second volume of the first of the Biographies of him published by his brother, contain a full statement of the relative claims of Sir H. Davy and George Stephenson respectively to be considered the inventor of the Safety Lamp. Upon another occasion, and as recently as 1864-1865, as may be seen by a reference to the pages of the Philosophical Magazine, Dr. Davy engaged himself in a vindication of his brother's reputation from certain aspersions which had been cast upon it with reference to his conduct when President of this Society.

Dr. Davy was the author of two works on Angling, which have the form of colloquies, and are discursive and digressive, especially in the direction of the various biological bearings of the sport. His liking for this pursuit was, as is well known from the 'Salmonia,' common to him with the author of that work.

Dr. Davy pursued a regular and methodical course of literary and scientific work up to the latest days of his life. His activity, as seen in his later years at the Meetings of the British Association, which he regularly attended, was the wonder of much younger men. Those who saw him in ordinary life gathered from the sight the moral that regular habits in ordinary life are the best guarantee for the possession of a power for putting forth extraordinary exertions upon extraordinary occasions.

The great reputation which, in spite of all efforts to the contrary, has settled round the name of Sir Humphry Davy, has necessarily put Dr. John Davy's claims for scientific distinction somewhat at a disadvantage. The younger brother's main deficiencies were deficiencies affecting his power of imagination and his faculty of exposition, and for excellence in these mental qualities the elder brother was not less preeminently distinguished than for his more strictly scientific abilities. It is much to the credit of Dr. Davy's moral nature that no shadow of mortification or jealousy ever darkened his meditations on his brother's achievements, into comparison with which he was so constantly forced to bring his own. Nor can we close this notice more fitly than by saying what is the literal truth, that his sympathy with the cause of his brother's reputation, showing itself as it did in a repeated and successful championship of it, elevated his whole nature and spread through and over his long series of labours the warm light of a sunny memory.